AD0766335

AFML-TR-73-83

MECHANICAL PROPERTIES, FRACTURE TOUGHNESS, FATIGUE, ENVIRONMENTAL FATIGUE CRACK GROWTH RATES AND CORROSION CHARACTERISTICS OF HIGH-TOUGHNESS ALUMINUM ALLOY FORGINGS, SHEET AND PLATE

C. F. Babilon, R. H. Wygonik, G. E. Nordmark
and B. W. Lifka
Aluminum Company of America

TECHNICAL REPORT AFML-TR-73-83
April, 1973

Air Force Materials Laboratory
Air Force Systems Command
Wright-Patterson Air Force Base, Ohio

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely related Government procurement operation, the United States Government thereby incurs no responsibility nor any obligation whatsoever; and the fact that the Government may have formulated, furnished, or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication or otherwise as in any manner licensing the holder or any other person or corporation, or conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

Copies of this report should not be returned unless return is required by security considerations, contractual obligations, or notice on a specific document.

AD766335

MECHANICAL PROPERTIES, FRACTURE TOUGHNESS, FATIGUE, ENVIRONMENTAL FATIGUE CRACK GROWTH RATES AND CORROSION CHARACTERISTICS OF HIGH-TOUGHNESS ALUMINUM ALLOY FORGINGS, SHEET AND PLATE

C. F. Babilon, R. H. Wygonik, G. E. Nordmark
and B. W. Lifka

FOREWORD

This investigation was conducted by the Alcoa Research Laboratories, Aluminum Company of America, New Kensington, Pennsylvania, under USAF Contract No. F33615-71-C-1571, Project No. 7381, "Materials Applications", Task No. 738106, "Engineering and Design Data". The work was under the direction of the Materials Laboratory, Wright-Patterson Air Force Base, Ohio, with Mr. A. W. Gunderson (AFML/MXE) as project engineer.

This report covers work done from May 1971 through February 1973.

The investigation was made under the supervision of Mr. C. F. Babilon with Mr. R. H. Wygonik as project leader for the phase covering the mechanical properties including fracture toughness and fatigue. Mr. G. E. Nordmark was the project leader for the phase covering the fatigue-crack propagation rates and Mr. B. W. Lifka was project leader for the phase covering the corrosion characteristics. The statistical analyses were made by Mr. R. H. Wygonik. Significant advisory and technical assistance were supplied by Messrs. J. G. Kaufman, R. A. Kelsey and D. O. Sprowls.

The report was released by the authors for publication in March.

This technical report has been reviewed and is approved.

Albert Olevitch

ALBERT OLEVITCH
Chief, Materials Engineering Branch
Systems Support Division
Air Force Materials Laboratory

ABSTRACT

The tensile, compressive, shear, bearing, fracture-toughness and axial-stress fatigue properties, fatigue crack growth rates and corrosion characteristics have been determined for a total of 21 lots of 7049-T73 and 7175-T736 forgings (≤5.000-in. thick), 25 lots of 7475-T61 and T761 sheet (0.032 through 0.249-in. thick) and 10 lots of 2124-T851 plate (1.75 through 6.00-in. thick). Supplemental data for bare and Alclad 7475 sheet and 2124-T851 plate are also presented.

Tables of computed design mechanical properties and typical stress-strain and compressive tangent modulus curves were prepared.

The plane-strain stress-intensity factor, K_{Ic}, was determined for the forging and plate samples and the critical stress-intensity factor, K_c, determined for the sheet samples.

Log-mean fatigue lives were calculated from tests made in ambient air. Axial-stress fatigue tests were also made in a salt fog environment.

The rates of fatigue crack propagation of these products generally do not vary significantly with specimen orientation. Humid and salt fog environments increased the rate of fatigue crack propagation for most specimens. Propagation is slower in 2124-T851 plate than for 2024-T851 plate but rates for sheet alloys 7475-T61, 7475-T761 and Alclad 7475-T61 are essentially equivalent as are rates for 7175-T736 and 7075-T7352 hand forgings.

The 7175-T736 forgings, 7475-T761 sheet and 2124-T851 plate have a high resistance to exfoliation while the 7049-T73 forging and the 7475-T61 sheet show some susceptibility to exfoliation. All of the materials are resistant to stress corrosion cracking when stressed in the longitudinal and long-transverse grain direction. The resistance to SCC in the short-transverse direction of all the materials is representative of the respective alloys and tempers.

Key Words: 7049, 7175, 7475, 2124, aluminum, die forgings, hand forgings, sheet, plate, tensile, compressive, shear, bearing, fracture-toughness, fatigue, crack propagation, stress-corrosion, exfoliation.

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS
(Continued)

LIST OF ILLUSTRATIONS

(Concluded)

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES

LIST OF TABLES
(Concluded)

LIST OF TABLES
(Continued)

LIST OF TABLES
(Concluded)

SECTION I

INTRODUCTION

A concerted effort has been made in recent years to develop information on the design mechanical properties, fracture toughness, fatigue, and corrosion characteristics of a number of high strength aluminum alloys in suitable tempers and products. Particular attention has been given in recent investigations to the influence of environment on properties, notably rates of fatigue crack growth, as the importance of this variable has become evident.

Within the past few years, several new high-toughness and/or corrosion resistant aluminum alloy products namely 7049-T73 and 7175-T736 die and hand forgings, 7475-T61 and T761 sheet and 2124-T851 plate were developed and have been evaluated in this investigation in a manner similar to that utilized in previous contracts[1-5]. Tests of these aluminum alloy products were made to provide statistically reliable data for deriving design mechanical properties for inclusion in MIL-HDBK-5B[6] and to develop typical stress-strain and compressive tangent modulus curves. Additional data concerning fracture toughness, axial-stress fatigue, fatigue crack growth rates and stress-corrosion characteristics of the materials have been obtained.

SECTION II

MATERIAL

A total of twenty-one 7049-T73 and 7175-T736 die and hand forging samples, twenty-five 7475-T61 and T761 sheet samples and ten 2124-T851 plate samples were obtained from three producers for this investigation. Three of the 7049 forgings and five of the 2124 plate samples were produced by Kaiser (designated hereafter as Producer B) and Reynolds (Producer C) with the remainder being produced by Alcoa (Producer A). Each of the samples were fabricated independently to represent an individual lot of material.

The identity, size and chemical compositions of the forging, sheet and plate samples, together with the respective specified composition limits, are shown in Tables I through IV. The compositions are within the applicable limits specified in the Interim Federal Specification QQ-A-00250/29, Aerospace Material Specifications 4111 and 4149 and "Aluminum Standards and Data", The Aluminum Association[7].

The samples represent commercial production material with a variety of thicknesses and grain flow patterns and provide adequate correlation to previous programs. Photographs of the 7049-T73 and 7175-T736 die forging samples are shown in Figs. 1 to 9.

SECTION III

PROCEDURE

A. Mechanical Properties

A.1. Tensile, Compressive, Shear and Bearing

The test specimens and procedures used were, in general, in accordance with ASTM Methods, and where appropriate the same as those used in previous investigations of plate, extrusions and forgings[1-5]. These methods are essentially in agreement with Federal Test Method 151[8].

The tests were conducted using the most appropriate load ranges of an Amsler 20,000-lb (Type 10SZBDA58), an Olsen Electomatic 30,000-lb, an Olsen Super-L 20,000-lb, or a Southwark-Tate-Emery 50,000-lb capacity Universal Testing Machine. The machines were calibrated prior to and during the investigation; the accuracy of each was within that required by ASTM(9) and Federal specifications.

Single specimens were tested except in a few instances where a review of the data indicated that check tests were needed.

Tensile, compressive, shear and bearing tests were made using longitudinal, long-transverse and short-transverse specimens from the hand forging and plate samples, longitudinal and short-transverse specimens from the die forgings and longitudinal and long-transverse specimens from the sheet samples. All specimens from the die and hand forgings were taken from the middle third of the cross-section; for the plate samples, longitudinal and long-transverse specimens were from the thickness/4 location and the short-transverse specimens from the thickness/2 location. All specimens from the sheet samples were full thickness with the exception of 3/16-in. diameter shear specimens tested from the 0.188-in. and 0.249-in. thick sheet.

Tensile tests of all the samples were made in accordance with ASTM Methods E8[10]. Tests of the forging and plate samples were made using 1/2-in. diameter tapered seat specimens except where it was necessary (in the short-transverse direction and across the parting plane) to use subsize round specimens. Tests of the sheet samples were made using full thickness standard 1/2-in. wide sheet-type specimens. The dimensions of the specimens are shown in Fig. 10.

Compressive tests of the forging and plate samples were made using 1/2-in. diameter x 1-7/8-in. long cylindrical specimens

having a slenderness ratio (l/r) of 15 and those from the sheet samples were full thickness sheet-type specimens (Fig. 11). The tests were conducted in accordance with ASTM Method E9(11) using a subpress (Fig. 3 of Methods E9). Lateral support of the sheet-type specimens was provided by a Montgomery-Templin jig (Fig. 4 of Methods E9). When possible, specimens 3/4-in. diameter and 3-1/2-in. long were used to determine the modulus of elasticity.

Tensile and compressive yield strengths were determined from autographic load-strain diagrams at 0.2 per cent offset.

Shear tests of the forging and plate samples were made using 3/8-in. diameter specimens (Fig. 11). Tests of the sheet samples were made in one of two ways: For sheet $\leq$0.063-in. thick, the blanking shear strength was determined by measuring the load required to punch a 2-3/4-in. diameter circle from a 4x4-in. blank with a hardened steel punch and die. For thicker sheet ($t \geq 0.187$-in.), 3/16-in. diameter specimens of the type used from the forging and plate samples were tested. The cylindrical specimens were tested with an Amsler double-shear tool in which a 1-in. length is sheared from the center of a 3-in. long specimen, the end thirds being supported throughout their lengths. For tests of the thinner plate and forging samples in the short-transverse direction, two specimens approximately 1-1/2-in. long were butted together at the center of the Amsler shear tool and tested simultaneously. In the tests of the longitudinal and long-transverse specimens, the loads were applied in the direction normal to the major surface of the samples; in the tests of the short-transverse specimens, the loads were applied in the direction parallel to the major axis[12].

Bearing tests were made in accordance with ASTM Methods E238-68[13], using longitudinal and long-transverse 1-1/2-in. wide or 2-in. wide sheet-type specimens of the type shown in Fig. 12. Edgewise specimens from the forging samples and specimens taken flatwise from the plate were machined 0.094-in. thick x 1-1/2-in. wide. Specimens from the sheet samples were full thickness x 1-1/2-in. or 2-in. wide. The bearing ultimate and yield strengths were determined at edge distances of 1.5 and 2.0 times the pin diameter. The bearing yield strength was determined as the stress at a permanent deformation of 2 per cent of the pin diameter as indicated on autographic load-deformation diagrams.

Tensile and compressive stress-strain tests, including modulus determinations were made of longitudinal, long-transverse and short-transverse specimens taken from a selected number of samples. The tests were, in general, conducted in accordance with ASTM Method E111[14] using uniform reduced-section specimens (Figs. 11 and 13). The strains were measured with two Tuckerman

optical strain gages positioned diametrically opposite over gage lengths of 1 in. or 2 in.; the smaller gage lengths were used to measure the strains of the smaller specimens. The instruments used meet the ASTM requirements of a Class A extensometer[15]. In several instances, where the specimens were too short to mount the Tuckerman optical strain gages, the strains were measured using Micro-Measurements Type EA-13-031CF-120 foil strain gages. The moduli of elasticity values were determined by the strain deviation method described in ASTM Method E111[14]. Representative typical tensile and compressive stress-strain curves and compressive tangent-modulus curves were then developed based on the data obtained from these tests. The procedures used in developing these curves are outlined in Sections 3.2.3, 3.2.5 and 3.2.6 of Technical Report AFML-TR-66-386[16].

A.2. Fracture Toughness

Duplicate fatigue cracked compact-tension specimens of the type shown in Fig. 14 were used to determine the plane-strain stress-intensity factor, K_{Ic}, of all the forging and plate samples. The specimen orientations (shown in Fig. 15), dimensions, chevron notching, fatigue cracking and testing procedures were essentially in accordance with ASTM Method E399-72[17]. The specimens were fatigue-cracked by axial loading (R=+0.1) in Krouse fatigue machines. The test setups for fatigue cracking and fracture toughness testing are shown in Figs. 16 and 17. The tests were made in a 30,000-lb capacity Olsen Electromatic testing machine and plots of load vs COD (crack opening displacement) were recorded using a Mosley X-Y plotter. Candidate values of critical plane-strain stress-intensity factor, K_Q, were calculated using the load at 5 per cent secant offset. If all the validity criteria specified in ASTM Method E399-72 were met, the candidate value was designated as K_{Ic}.

The critical stress-intensity factor, K_c, of all the sheet samples were determined from tests of 16-in. wide center slotted panels of the type shown in Fig. 18[18] using guidelines published some years ago[19]. The specimens were loaded monotonically (Fig. 19) in an Amsler 300,000-lb capacity testing machine; no anti-buckling guides were used. The crack opening displacement was measured over an 11.3-in. gage length. Plots of load vs COD were made using a Mosley X-Y plotter. The critical crack lengths were measured two ways: (1) the ink stain method where ink follows the slow crack growth and (2) conversion of COD to crack length measurement through a compliance calibration. The critical stress-intensity factor, K_c, was calculated at the point of instability to complete fracture using the two values of critical crack length. Plots of the data were presented using the technique proposed by C. E. Fedderson[20]. In addition, crack resistance curves of the materials were developed as described by Heyer and McCabe[21].

A.3. Axial-Stress Fatigue

Tests of smooth and notched axial-stress fatigue specimens of the types shown in Figs. 20 and 21 were made at three stress levels (R=0.0) using appropriate specimens taken in the longitudinal and long-transverse directions from selected forging, sheet and plate samples. Single tests of the remaining samples were made at the corresponding intermediate stress level. All of the tests were made in Krouse fatigue machines operating at 13.3, 25.0 or 28.8 Hz.

Smooth and notched specimens having test sections similar to those shown in Figs. 20 and 21 were subjected to axial-stress fatigue tests (R=0.0) in a salt fog environment. These specimens were taken in the long-transverse direction from two thicknesses of each of the three products. A chamber was placed around the test section and the specimen was subjected to a 20-second spray of a 3-1/2% salt solution at 5-minute intervals. The tests were made in 5-kip capacity Krouse fatigue machines operating at 18.3 Hz.

B. Fatigue Crack Propagation Tests

Fatigue crack propagation rates for the sheet samples were determined using full thickness, center-notch specimens as shown in Fig. 22. Center-notch specimen, Fig. 23, and compact tension type specimen, Fig. 24, were used for the plate and hand forgings. Data were developed for each alloy and temper in: (a) Dry air, (b) Humid air and (c) 3-1/2% NaCl salt fog. Specimens were taken from two thicknesses of each alloy and temper; for the thicker product, the effect of specimen orientation was studied. Some tests were also made to determine the effect of load level.

The center-notch specimens contained a 0.20-in. long EDM (electrical discharge machining) crack-starter notch. The specimens were precracked to obtain an initial crack length of 0.5 in., from which point crack propagation data were recorded; the final 0.1 in. of precracking was carried out at test loads. The sheet specimens were tested in a 15-kip Krouse fatigue machine as shown in Fig. 25 at a frequency of 13.3 Hz. The tests of the 3/4-in. thick center-notch specimens were made in 50,000-lb capacity structural fatigue machines of the type shown in Fig. 26, at a frequency of 5.2 Hz. The compact tension type crack propagation specimens were tested in a 5-kip Krouse machine at a frequency of 18.3 Hz using fixtures similar to those shown in Fig. 27. As for the center-notch specimens, the compact tension specimens were precracked, with the last 0.10 in. of precracking being performed at test loads. The compact-tension type specimens were utilized for the short-transverse specimens and the long-transverse specimens from the smaller forgings. Both center-notch and compact tension

specimens were taken in the long-transverse direction of the 5x20-in. hand forgings so that the effect of specimen type could be determined. All tests were performed at a stress ratio of one-third ($R=+1/3$).

For most specimens, the crack propagation was determined by taking periodic measurements of the crack length using a magnifier to read a grid photographically reproduced on the specimen.

To control the test environment, the test section of each specimen was contained in a chamber such as shown in Figs. 2 and 28. Dry air (relative humidity $\lessapprox 10$ per cent) was obtained using dessicants; humid air (relative humidity $\gtrapprox 90$ per cent) was obtained by having a water reservoir in the chamber. For the tests at 5.2 Hz, the salt fog consisted of a one-minute spraying of 3-1/2% NaCl saltwater solution into the compartment at 15-minute intervals. For tests at 13.3 and 18.3 Hz, a 20 second spray was applied at 5-minute intervals.

Crack length (a) was plotted as a function of the number of cycles (N). The rate of fatigue crack growth, da/dN, was determined by fitting a second degree polynomial through each three successive data points. The rates of crack growth were plotted as a function of ΔK, the range of stress intensity factor, where K is defined as follows:

$$K = Y \frac{P\sqrt{a}}{BW}$$

Where a = crack length, in. (half of total crack length for center-notch specimens)

B = specimen thickness, in.

W = specimen width, in. (load line to end of specimen for compact tension specimen)

P = load, kips

$$Y = (\text{center-notch specimen}) = 1.77 + 0.277\left(\frac{2a}{W}\right) - 0.510\left(\frac{2a}{W}\right)^2 + 2.7\left(\frac{2a}{W}\right)^3 \qquad \text{(Ref. 23)}$$

$$Y = (\text{compact-tension specimen}) = 30.96 - 195.8\left(\frac{a}{W}\right) + 730.6\left(\frac{a}{W}\right)^2 - 1186.3\left(\frac{a}{W}\right)^3 \qquad \text{(Ref. 24)}$$

(H/W = 0.485, where H is one-half the specimen height)

These data were computer analyzed and plotted.

C. Corrosion Characteristics

C.1. Resistance to Exfoliation

Resistance to exfoliation of each of the items was evaluated by means of 2x4-in. panels machined to the T/10 plane (10% of the section thickness machined from one of the fabricated surfaces) and exposed to the EXCO test per ASTM Standard Test Method G34-72(25). The EXCO test involves total immersion for 48 hours (144 hours used for 2124-T851 plate) to a 4N. NaCl + 0.5N. KNO_3 + 0.1N. HNO_3 solution. In addition, selected lots of each product were exposed for one week to the acidified salt spray test required by Military specifications for T76 temper products and to seacoast atmosphere at Point Judith, Rhode Island. Specimens exposed to the two accelerated environments were rated visually according to the classifications and photographic standards contained in ASTM G34-72.

C.2. Resistance to Stress-Corrosion Cracking (SCC) - Smooth Specimens

C.2.1. Forgings and Plate

The resistance to SCC of susceptible aluminum alloys and tempers is most critical in the short-transverse direction (perpendicular to or across the parting plane in the case of die forgings); consequently the majority of tests were made on specimens oriented in this direction. Certain items of each product were also tested in the longitudinal and long-transverse directions.

The principal test specimen used was a 0.125-in. diameter threaded end tensile specimen meeting the requirements of ASTM Method E8(10). Specimens were centered in the product thickness; except that for die forgings they were taken across the parting plane, 3/8 in. below the base of the flash or as close thereto as possible. For die forgings where the parting plane is located at one surface, specimens were taken perpendicular to the parting plane. The cross-section of the various die forged shapes at the region tested and the position of the test specimen are shown in Fig. 29. In addition two of the die forgings were tested using specimens positioned 3/16 in. from the flash and one flat shape was tested using 3/4-in. O.D. C-rings positioned 3/8 in. from the flash (Fig. 29). In some cases where quick failures were encountered, retests were made using a 0.225-in. diameter specimen.

Unstressed specimens were exposed in duplicate and stressed specimens in triplicate. Tensile specimens were stressed

in direct tension using Alcoa's wedge-load stressing frames (Fig. 30); the amount of stress being determined by measurement of the induced strain. C-ring specimens were stressed by applying a calculated amount of deflection. Stress levels used were:

(a) Longitudinal and long-transverse specimens - 75% of the actual yield strength

(b) Short-transverse specimens: 7049-T73 - 45* and 35 ksi
7175-T736 - 45, 35* and 25 ksi
2124-T851 - 75% of actual short-transverse yield strength and 58 and 50%* of the guaranteed long-transverse yield strength, (G.Y.S.).

Note: * Quoted capability in 30 day, 3.5% NaCl alternate immersion test.

The corrosive environments used were: (a) 84 days exposure to 3.5% NaCl by alternate immersion per Federal Test Standard 151b, Method 823[8], (b) seacoast atmosphere at Point Judith, R.I., and (c) industrial atmosphere at New Kensington, Pa. Atmospheric tests were scheduled for a minimum of 4 years exposure, but at report time had completed only about one year.

C.2.2. 7475 Sheet

Stress-corrosion tests of the sheet were made with two types of long-transverse specimens: a premachined tensile specimen (per ASTM Method E8) and a plastically deformed tensile specimen blank. Full thickness specimens were used for the 0.040 and 0.063-in. sheet; for thicknesses greater than 0.063-in., were machined on one side to 0.063 in. and the rolled surface was stressed in tension. Both types of specimens were stressed in bending by arcing them in a constant span fixture (Fig. 31); the tensile specimens being end-milled to a length to provide a stress of 75 per cent of the actual yield strength. Unstressed tensile specimens were also tested. All specimens, stressed and unstressed, were exposed to the 3.5% NaCl alternate immersion test per Federal Test Standard 151b, Method 823.

C.3. Resistance to SCC - Precracked Specimens

Stress corrosion tests of precracked specimens were made using duplicate, short-transverse, bolt-loaded double cantilever beam (DCB) specimens of the type shown in Fig. 32, taken in the S-L orientation. The items tested were; the die forged shape 9078 and the 2 and 5-in. thick hand forgings of

both 7049-T73 and 7175-T736 alloys, plus the 5 lots of 2124-T851 plate fabricated by producer A. Specimens from the hand forgings and plate were 1x1x5 in., centered in the product thickness. Prior to obtaining the DCB specimens longitudinal slices from the hand forgings were macroetched to ensure that the specimen precrack was in line with the grain flow (Fig. 33). Specimens from the die forgings were 9/16x1x5 in. because of the forging geometry and were taken from the flange just below the parting plane and from the central web of the forging (Fig. 34).

The specimens were precracked in tension and loaded to pop-in (the first indication of unstable crack growth), the crack being innoculated with 3.5% NaCl solution at the time of pop-in. The specimens were then exposed for 30 days in an air environment of 80 F and 45 per cent relative humidity. Three times each working day, a few drops of 3.5% NaCl solution were dripped into the crack. This specimen and test procedure was developed by Boeing in their ARPA program No. 878[26]

SECTION IV

RESULTS OF TESTS

The results of the individual tensile, compressive, shear and bearing tests, including some supplemental data from 38 lots of bare and Alclad 7475 sheet and 9 lots of 2124-T851 plate, the ratios among these test results, the statistical analysis of these ratios, and the computed design values are shown in Tables V through XLI. Typical tensile and compressive stress-strain and compressive tangent-modulus curves are shown in Figs. 35 through 41.

The results of the compact-tension fracture toughness tests and those of the wide center-slotted panels are shown in Tables XLVIII through LV. Also included are the results of some supplemental compact-tension and wide center-slotted panel fracture toughness tests.

The results of the smooth and notched axial-stress fatigue tests (R=0.0) are shown in Tables LVI through LXI and Figs. 53 through 66. Those of smooth and notched long-transverse specimens in salt fog environment are presented in Tables LXII and LXIII and Figs. 67 through 71. For comparison, scatter bands of the long transverse specimens tested in air are also shown.

The results of the fatigue crack growth tests are plotted in Figs. 72 through 91 and summarized in Table LXIV. In each case, the raw data are presented in the a version of each figure and the ΔK vs, da/dN data are shown in the b version. In the following evaluations differences in fatigue crack-growth rates of less than 50 per cent are not considered significant.

A description of the visual ratings of exfoliation specimens contained in ASTM Method G34-72 is given in Table LXV and an example of the four degrees of exfoliation is shown in Fig. 92. Results of the exfoliation tests are given in Tables LXVI through LXIX and Figs. 93 and 94.

The results of stress corrosion tests with smooth specimens are shown in Tables LXX through LXXVII and Figs. 95 through 98. Results of tests with precracked specimens are in Table LXXVIII and Figs. 99 through 102.

SECTION V

DISCUSSION OF RESULTS

A. Mechanical Properties

A.1. Tensile, Compressive, Shear and Bearing

The tensile properties of each sample of each product tested exceeded the respective specified minimum property requirements (Table XIV).

The strengths of the 7049-T73 and 7175-T736 forgings (Tables V to VIII) are comparable based on the direct comparison of the values determined for identical shapes (Sample Nos. 410698 and 410699 and Sample Nos. 410697 and 410705). Harmsworth[27] in his evaluation of several landing gears indicated tensile properties of 7049-T73 forging samples to be 2 to 3 ksi higher than those of 7175-T736 forgings. Other investigations[28,29,30] of 7049-T73 and 7175-T736 forgings indicated properties comparable to those determined in this investigation.

The tensile properties of bare 7475-T61 sheet are higher than those of bare T761 sheet (Tables IX and X) and similar to those reported by R. R. Cervay[31].

Evaluation of the tensile and compressive properties of the 7049-T73 die forgings (Table V) and 2124-T851 plate (Table XII) indicated some apparent differences in the materials fabricated by the different producers. However, whether or not these differences are significant is questionable because of the small number of samples. The longitudinal tensile, tensile yield and compressive yield strengths of the 7049-T73 forgings fabricated by Producer A are considerably higher than those from Producer B (Table V). In the case of the 2124 plate (Table XII), for thicknesses greater than 4.000-in., the properties of plate from Producer A are somewhat higher than those of plate from Producer C.

The ratios among the tensile, compressive, shear and bearing properties of the individual 7049-T73 and 7175-T736 die and hand forging samples are shown in Tables XV through XVIII; the ratios among the properties of the 7475-T61 and T761 sheet samples and the ratios among the properties of the supplemental bare and Alclad 7475-T61 and T761 sheet samples are shown in Tables XIX and XX. The ratios among the properties of the contract and supplemental 2124-T851 samples are shown in Table XXI.

The statistical analysis of the ratio data were made in accordance with the procedures outlined in MIL-HDBK-5 Guidelines for presentation of Data(21). A regression analysis of each group of ratios was made to determine whether the data showed a significant correlation with thickness. Whenever a significant correlation with thickness was indicated, values of minimum ratios, Min $\bar{R}$, were selected which correspond with the lower limit of the confidence band around the regression line at the lower end of each respective thickness range. When no correlation was indicated, a single minimum value of $\bar{R}$ was selected for all thicknesses. These values of minimum $\bar{R}$ were used for determining derived design values for the respective thickness ranges.

No statistical analysis was made on a population containing less than eight data points. When a population of less than eight data points was encountered, the mean value, $\bar{R}$, was determined and adjusted downward by a factor of 0.01, the same decrease generally indicated when larger populations were analyzed statistically.

In view of the test variables (specimen alignment, contaminated test surfaces, etc.) that may affect the results of the bearing tests, some broader adjustments were made to the ratios. The bearing ratios for the bare and Alclad 7475-T61 and T761 sheet (L plus LT directions) were combined into four groups (BUS, BYS, 1.5D and 2.0D), analyzed as individual groups with a single minimum value, Min $\bar{R}$, being determined for each property and condition. The ratio values of Min $\bar{R}$, for all bearing tests, were then rounded to the nearest 0.05.

The distribution of the ratios, and the values for the various terms in the statistical analyses, are shown in Tables XXII through XXVIII. The results of the statistical analysis of the die and hand forging samples and bare and Alclad 7475-T61 and T761 sheet samples indicate, with the exception of the short-transverse compressive yield strength of the die forging samples, that no correlation with thickness exists among the ratios. The results of the statistical analysis of the data for plate indicate that all of the shear and bearing yield ratios (1-1/2D and 2D) show a general increase in most of the ratios with increase in thickness, while the longitudinal compressive yield shows a general decrease.

Since the shear and bearing tests were made with specimens taken in two or three directions (L, LT and ST), the Student's "t" test and the "f" test were applied to the ratios of each direction to determine if there were significant differences in the average ratios or in the variability for the different directions. Where none was indicated, the ratios for the different directions were combined for computation of the minimum ratios to be used; where

there was a significant difference, the most conservative value was used. No differences with direction were found in the shear and bearing ratios of the forgings, sheet and plate samples, except for the short-transverse shear strength ratios of the 2124-T851 plate. In the case of the hand forging samples, where there were so few tests, the L and LT bearing ratios were combined even though the statistical tests suggested they may not have come from the same population.

The ratio values used in computing the design values from the specified tensile properties of the respective thickness ranges of each alloy and product are summarized in Tables XXIX through XXXIV. The corresponding computed design values for each of the alloys and products are summarized in Tables XXXV through XLI; also shown, when applicable, are the differences between these values and the corresponding values presently in MIL-HDBK-5B.

In preparing the design tables for 7049-T73 die and hand forgings and 7175-T736 die forgings, the respective tensile-property values in AMS-4111 and 4149, as shown in Table XIV, were used as basis property "S" values. The tentative values for 7175-T736 hand forgings, 7475 sheet and 2124-T851 plate were based on Alcoa production data. The basis property values and the ratios shown in Tables XXIX through XXXIV, were used in computing the remaining design values.

The derived compressive and shear values of the 7049-T73 hand forgings differ no more than ±2 ksi from the design values now published in MIL-HDBK-5B. Other than the tensile property values for 7049-T73 and 7175-T736 die forgings; no design values are shown for the remaining alloys in MIL-HDBK-5B.

The results of the tensile and compressive stress-strain tests, including modulus, are shown in Tables XLII through XLV and the average modulus values are shown in Table XLVI.

The results of the modulus tests indicated small differences in the modulus values with respect to direction (L, LT and ST). For the 7049-T73 and 7175-T736 die forgings, the tensile and compressive modulus values in the longitudinal direction were about 0.5 to 2.2 per cent higher than the short-transverse values; for the hand forgings, the long-transverse values were about 0.8 to 2.0 per cent higher than the longitudinal and short-transverse values. With one exception, the difference in modulus values with respect to direction for the 7475 sheet and 2124 plate was 0.7 per cent or less.

The average tensile and compressive modulus values of alloys and products are as follows:

Alloy	Product	Modulus, 10^3 ksi Tensile	Compressive
7049 & 7175	Die Forgings	10.2	10.7
7049 & 7175	Hand Forgings	10.2	10.6
7475	Sheet	10.0	10.5
2124	Plate	10.4	10.9

The average moduli for each product are indicated to be 4 or 5 per cent higher in compression than in tension.

The modulus values shown for the 7000 series forgings are about the same as those shown in MIL-HDBK-5B and slightly less, in most cases, than those determined in previous contracts on stress-relieved plate(1), extrusions(3) and forgings(5). For the typical stress-strain and compressive tangent modulus curves, the modulus values shown in the summary table above were used.

The results of the analysis of the individual stress-strain tests indicated that, for a given alloy, temper and direction, no apparent trend with thickness in the offsets from the modulus line at stresses expressed in per cent of the yield strength was evident. Typical tensile and compressive stress-strain and compressive tangent modulus curves have been prepared for each alloy and product and are shown in Figs. 35 through 41. The curves were derived and are presented in accordance with the procedures outlined in MIL-HDBK-5 Guidelines for Presentation of Data(16). The tensile yield strengths used in deriving the typical stress-strain curves are the typical values (Table XLVII) indicated in Alcoa's production in recent years; it is assumed that these values would be representative for the industry. The compressive yield strengths were based on the average of the ratios encompassed by the specified thickness range for the typical tensile values.

A.2. Fracture Toughness

The results of the compact-tension fracture toughness tests of the forging and plate samples are shown in Tables XLVIII through LI. Supplemental fracture toughness data for nine lots of 2124-T851 plate are shown in Table LII.

About 1/5 of the candidate K_{Ic} values determined from tests of 7049-T73 forgings and about 2/3 of those determined from tests of 7175-T736 forgings are not strictly valid by all the criteria of the ASTM Standard Method of Test for Plane-Strain Fracture Toughness of Metallic Materials(17). However, as indicated in the tables most of these calculated values are considered meaningful values of K_{Ic} since the validity criteria were exceeded by only a small amount. The data from both the forgings and plate indicate

that the fracture toughness of each alloy and product is greatest in the longitudinal (L-T or L-S orientations) direction and generally lowest in the short-transverse (S-L orientation) direction.

The average K_{Ic} values determined are summarized as follows along with some data from previous contracts:

Alloy and Temper	Product	K_{Ic}, ksi$\sqrt{in.}$ L-T & L-S	T-L	S-L
7049-T73	Die Forging	31.2	--	22.5
	Hand Forging	29.8	20.9	19.9
7175-T736	Die Forging	35.1*	--	25.8
	Hand Forging	34.6*	26.9	23.3
7075-T7352+	Forgings	31	25	21
2124-T851	Plate (Producers A & C)	29.6	24.3	22.2
2024-T851+	Plate	23	20	17

* Average of all K_Q values considered meaningful.
\+ Average values shown in MIL-HDBK-5B.

As shown in the above table, the 7175-T736 forgings exhibit average long-transverse and short-transverse (T-L and S-L orientations) K_{Ic} values 2 to 6 ksi$\sqrt{in.}$ higher than the corresponding values exhibited by the 7049-T73 forgings, consistent with the findings of Harmsworth(27). In the longitudinal direction (L-T or L-S orientations) alloy 7175 was able to develop only two fully valid K_Q values because of inability to take large enough specimens to meet the thickness criterion. However, these values do provide a good indication of the toughness that can be expected for 7175-T736 forgings.

No significant difference in the toughness of the 7049-T73 die forgings from the different producers was noted.

The K_{Ic} values determined for the 2124-T851 plate from Producers A and C and the supplemental lots are in the range expected for 2124-T851 plate; the values for the plate from Producer B are lower and more typical of commercial 2024-T851 plate. In view of this, data for 2124-T851 plate for Producer B was excluded from the average values.

The following general observations concerning the toughness of the contract material as compared to data from MIL-HDBK-5B can be made:

a) 7049-T73 die and hand forgings - about equal to 7075-T7352 forgings in the L-T or L-S and S-L orientations and less than 7075-T7352 forgings in the T-L orientation.

b) 7175-T736 die and hand forgings - greater than 7075-T7352 forgings.

c) 2124-T851 plate (Producers A & C) - greater than 2024-T851 plate.

The results of 16-in. wide center slot fracture toughness specimens from the 7475-T61 and T761 sheet samples are shown in Tables LIII and LIV. Supplemental fracture toughness data from 3 lots (24 tests) of Alclad 7475-T61 sheet are shown in Table LV.

As a result of the high toughness of alloy 7475 in the T761 temper, nearly half of the candidate K_c values were from tests in which the net section stress exceeded 0.8 of the tensile yield strength, indicating excessive yielding in the tests. Although these values are not valid, they are useful in indicating the general toughness level of the material. Only three tests of the 7475-T61 sheet and four of the Alclad 7475-T61 sheet resulted in invalid tests; these also were considered indicative of general toughness levels.

Tests of center-slot specimens having an original crack length of 2t(0.125 in.) and modified center slot specimens (0.250-in. crack length and specimen width 14 in.) failed prematurely at the grip end. Although the fractures occurred prematurely, the high toughness of 7475 was evident since the net section stress developed by each specimen was about equal to the tensile yield strengths of the samples.

The critical stress-intensity factor, K_c, from the other tests was calculated using crack lengths obtained in two ways: the ink stain method where the ink follows the flow crack growth and the critical crack lengths are measured to the nearest hundredth of an inch with scale and dividers and by the compliance method where the critical crack lengths were determined by measurement of the secant offset to the fracture instability and conversion of the offset to crack length. The K_c values determined using both crack lengths are shown in the tables. It should be noted that the visual measurements generally result in the more conservative K_c value, as expected since no plastic zone correction was used with the visual measurements while the compliance technique automatically compensates for crack tip plasticity. The K_c values are presented for the T61 and T761 tempers in Figs. 42 and 43 as a function of thickness.

As may be noted in the table below, the critical stress-intensity factor, K_c, indicate substantially greater toughness for bare and Alclad 7475 sheet than for 7075-T6 sheet, and toughness comparable to that of 2024-T3 sheet from previous tests of 16-in. wide panels.

Alloy and Temper	Critical Stress-Intensity Factor, K_c, ksi$\sqrt{in.}$			
	L-T		T-L	
	Visual	Compliance	Visual	Compliance
7475-T61	98.9	105.0	92.0	96.4
7475-T761	106.0	119.4	101.4	112.5
Alc7475-T61	87.4	93.6	85.7	94.4
7075-T6	65.0	--	60.0	--
2024-T3	95.0	--	80.0	--

The K_c values for 7475 sheet are high enough that the toughness of the alloy cannot be fully appreciated from tests of small panels; tests of much larger panels would be required to illustrate the full potential of the material. For example, in tests of 10-ft wide panels, Wang, of McDonnell Douglas, obtained values ranging from 130 to 160 ksi$\sqrt{in.}$[32]. In similar tests of 2024-T3, they obtained values ranging from 150 to 175 ksi$\sqrt{in.}$ This substantiates that the toughness of 7475 sheet approaches that of 2024-T3 and is vastly superior to that of 7075-T6.

In addition to the above analysis of the K_c values, crack resistance curves were developed for some of the T61 and T761 samples using the methods recommended by R. H. Heyer and D. E. McCabe[21] and are shown in Figs. 44 to 47. The developed curves show the crack growth resistance of a material as a function of crack extension and indicate that a crack in alloy 7475 may be expected to start to grow at a critical stress-intensity value, K_c, of about 40 ksi$\sqrt{in.}$ but will continue to remain stable until R values well in excess of 100 ksi$\sqrt{in.}$ are attained with a crack growth of over 1 in. Analysis of the data also indicates the curves to be similar to those (Fig.48) developed for 7475 sheet by other investigators[32,33,34,35].

Some of the K_c data was also analyzed using the method recommended by C. E. Fedderson[20], the results of which are shown in Figs. 49 to 52. Three "damage" levels are presented and are identified as "threshold" (beginning of slow crack growth and plasticity), "apparent" (no crack growth at critical instability) and "critical" (total crack plus crack growth at critical instability). The data suggest that the 7475-T761 sheet has a slightly higher critical damage level but a somewhat lower threshold level than the T61 sheet. However, the data do not fit the analysis well, possibly because anti-buckling guides were not used.

A.3. Axial-Stress Fatigue

A.3.1. Ambient Air Environment

The results of axial-stress fatigue tests (R=0.0) of smooth and notched specimens taken in the longitudinal direction of the die forgings and longitudinal and long-transverse direction of the hand forgings, sheet and plate are summarized in Tables LVI through LXI and shown in Figs. 53 to 66. Log-mean fatigue life values for many of the preselected stress levels are shown in the tables and curves have been drawn through these points in the figures to indicate the trend of the data. Log-mean lives could not be calculated for many of the tests made at the two lower stress levels, since at least one specimen did not fail within the number of cycles allotted for the test.

There does not appear to be any consistent correlation between the fatigue life and product thickness; except that for the 7175-T736 hand forgings, the fatigue lives of the smooth specimens tend to decrease with increasing thickness.

The following general observations have been made concerning the smooth and notched (K_t=3) log-mean fatigue lives of the various alloys, tempers and products:

7049-T73 and 7175-T736 Die Forgings (Figs. 53 through 56)

a) the longitudinal fatigue lives of both alloys are about the same; however, the smooth specimen fatigue lives of 7175-T736 at the low stress level are longer than those of 7049-T73.

b) at the high stress level, the lives of both alloys are about equal to or longer than those shown for 7075-T7352 hand forgings; at the low stress level, the lives are shorter.

7049-T73 and 7175-T736 Hand Forgings (Figs. 57 through 60)

a) the smooth longitudinal fatigue lives of 7049-T73 are longer than the long-transverse lives.

b) except for the 7049-T73 long-transverse fatigue lives at the low stress level being shorter, the fatigue lives of both alloys are about the same.

c) the lives of both alloys are longer than those shown for 7075-T7352 hand forgings.

7475 Sheet Figs. 61 through 64)

a) at high stress levels, 7475-T61 shows longer lives than 7475-T761; at the lower stress levels, they are about the same.

b) the lives of the 7475-T61 and T761 are about equal to or greater than those of 2024-T3 and 7075-T6 sheet.

2124-T851 Plate (Figs. 65 and 66)

a) at the high stress level, the lives are about the same as those of 2024-T851 plate; at the low stress levels, the lives are shorter.

A.3.2. Salt Fog Environment

The salt fog environment lowers the fatigue strength of all products (Table LXIII and Figs. 67 through 71). As is common in corrosion-fatigue tests, the effect of the environment is greatest at the lower stresses where the time of exposure is longer. Further, the reduction in long-life fatigue strength is greater for the smooth than for the notched specimens. The number of corrosion-fatigue tests was small and several specimens failed outside the reduced section although such areas were coated with paint. However, the following observations can be made concerning the effect of the salt fog on the various alloys, tempers and products:

7049-T73 and 7175-T736 Hand Forgings (Fig. 67 and 68)

a. The results for the smooth specimens of the two alloys appear equivalent.

b. The notched 7049-T73 specimens have higher corrosion-fatigue strengths than the 7175-T736 specimens.

c. The fatigue strength is generally higher for the thicker forgings.

7475-T61 and T761 Sheet (Figs. 69 and 70)

a. For both smooth and notched specimens, the salt fog environment has a greater effect on the thinner sheet.

b. The lives of the 7475-T61 and T761 specimens appear to be equivalent.

2124-T851 Plate (Fig. 71)

a. The smooth and notched specimens from the 2-in. thick plate tend to have higher fatigue strengths than the corresponding specimens from the 4-1/2-in. plate.

b. The fatigue strengths of smooth 2124-T851 plate specimens tested in salt fog approximate those obtained for the 7175-T736 forgings (Fig. 68), although the fatigue strength in air is substantially higher for the forging. Thus, the environmental effect is less for 2124-T851 plate than for 7175-T736 forgings.

B. Fatigue-Crack-Propagation Tests

Generally, crack-growth rate is significantly faster in humid air and salt fog than in dry air, especially at the lower growth rates. As discussed below, the notable exception is in the S-L and S-T specimens, wherein the crack growth rate in the humid environments are either comparable or slower than that in dry air. There is generally good agreement between the da/dN-ΔK relationships for tests made of duplicate specimens where the tests were made at either low or high loads, with an overlapping ΔK range. The effects of orientation, specimen type and environment are discussed below.

7049-T73 Hand Forgings

a) For tests in both dry and humid air, the rates of fatigue-crack-propagation determined for T-L (long transverse) compact tension specimens are comparable for the 4x16-in. and 5x20-in. forgings, Figs. 72 and 73, respectively. Growth rates determined using center-notch specimens (Fig. 74) are generally agreeable with those for the compact tension specimens.

b) In all three environments crack propagation is slower for the L-T (longitudinal) specimens (Fig. 75) than the T-L specimens (Fig. 74) at the higher stress intensities.

c) The rates of crack propagation for the S-T (short transverse) specimen tested in dry air (Fig. 76) are surprisingly, slower than those obtained in humid air and faster than those of the corresponding T-L specimens. The specimen used for the test in humid air demonstrated much greater resistance to crack propagation during the precracking stage; apparently, this behavior carried over into the propagation stage of the test. (Fractographic examination is being made to determine if there is an explanation for this behavior. The results will be inserted into the final report.)

7175-T736 Hand Forging

a) In all environments the rates of fatigue-crack-propagation determined using compact tension specimens taken in the T-L direction are comparable for the 4x16-in. and 5x20-in. hand forgings, Figs. 77 and 78, respectively.

b) For the 5x20-in. forging, the crack propagation rates determined using T-L center-notch specimens (Fig. 79) are comparable to those obtained using T-L compact tension specimens (Fig. 78) for each environment. The results for one center notch specimen, WL5, indicate that the salt fog increases the rate of propagation over that of specimens tested in humid air, whereas,

the results for specimen WL6, tested at a load 63 per cent higher, indicate equivalent results for tests in humid and salt fog environments; this may result from the reduced time of exposure at the higher load. The effect of the humid air and salt fog environments is comparable to T-S specimens from 7075-T7352 hand forgings.

c) For the L-T specimens, the salt fog doubled the rate of crack growth (Fig. 80). In the dry and humid air the rates of crack growth are equivalent to those determined for T-L specimens (Fig. 79).

d) The rates of propagation for L-T and T-L specimens in dry air are equivalent to those of similar specimens from a 7075-T7352 hand forging tested previously(5) in ambient air (5 to 50 per cent relative humidity).

e) Crack propagation of the S-T specimens (Fig. 81) appears to be unaffected by humidity or salt fog. At the lower stress intensities, crack propagation is slower for the S-T specimens than for the T-L specimens (Fig. 78). Further, at the lower stress intensities, crack propagation is significantly slower than that of S-L center-notch specimens from a 7075-T7352 hand forging(5) (15 to 50 per cent humidity).

f) At the higher stress intensities, the rate of fatigue-crack-propagation for the 7175-T736 T-L specimens is generally slower than that of similar specimens from the 7049-T73 hand forgings.

7475-T61 and 7475-T761 Sheet

a) For a given temper and environment fatigue crack growth rates are comparable for the T-L and L-T specimens (Figs. 82 through 87).

b) The fatigue-crack-propagation behavior of the specimens from the T61 and T761 tempers are generally equivalent in both the dry air and salt fog environments. In humid air, propagation is somewhat slower in the 0.125-in. 7475-T761 sheet than in the T61 sheet.

c) Fatigue-crack-propagation in sheet of either temper is two to three times faster in humid air than in dry air and about four times faster in the salt fog environment than in dry air.

d) The data for tests in dry and humid air generally bracket the average curve representing unpublished Alcoa Research Laboratory data for 0.090-in. thick Alclad 7475-T651 sheet tested

in ambient air (generally within the range of 25 to 50 per cent relative humidity). Apparently the cladding does not greatly affect the rate of fatigue-crack propagation.

2124-T851 Plate

a) In dry air the rates of propagation in the T-L specimens from the 4.5-in. plate (Fig. 89) are lower than those from the 2-in. plate (Fig. 88). The growth rates for the two thicknesses of plate are equivalent in both the humid air and salt fog environments.

b) The L-T specimens (Fig. 90) have somewhat slower rates of propagation than the T-L (Fig. 89) specimens in the ΔK range of 10-15 ksi$\sqrt{in.}$

c) The fatigue-crack-propagation rates determined for compact tension type, S-L specimens (Fig. 91) are comparable to those determined for center-notch, T-L specimens.

d) For both L-T and T-L specimens, crack growth is slower than indicated by the average curves for 2024-T851 plate[3,36].

e) Several delays (one to eleven days) occurred in the test of specimen LTF9 (Fig. 89) in salt fog, which may have resulted in blunting of the crack tip. The a vs N and da/dN vs ΔK data for this specimen was quite erratic. Accordingly, most of the subsequent tests in salt fog were conducted in a single day's testing time. The propagation of the few specimens subjected to a single overnight delay does not appear to be affected by the delays.

f) Crack propagation was not accelerated appreciably by the humid or salt fog environments.

C. Corrosion Characteristics

C.1. Resistance to Exfoliation

C.1.1. 7049-T73 and 7175-T736 Forgings

In general, the 7049-T73 and 7175-T736 die and hand forgings, showed a high degree of resistance to exfoliation, with the 7175-T736 forgings being the more resistant of the two alloys. The only forging showing appreciable exfoliation was the 5-in. thick 7049-T73 hand forging, S. No. 410688 (Table LXVI). Two other 7049-T73 forgings (S. Nos. 410698 and 410686, Table LXVI) and one 7175-T736 forging (S. No. 410699), Table LXVII) developed very minor exfoliation, but because some was present they had to be rated in the E-A category (Table LXV and Fig. 92). However, the degree of susceptibility in the latter three forgings was so slight that it is quite likely they will not exfoliate in the seacoast atmosphere.

C.1.2. 7475 Sheet

The 12 lots of 7475-T61 sheet showed some exfoliation, with one lot showing appreciable exfoliation to a C degree. In contrast, all the 7475-T761 sheets encountered only pitting attack, Table LXVIII. The visual appearance of representative specimens is shown in Fig. 93. The form of corrosion present on the 7475-T61 sheet, S. No. 410658 was obviously exfoliation. However, one might question whether the remaining T61 lots incurred exfoliation or a severe degree of pit-blistering and also whether the T761 lots were completely free of exfoliation. Metallographic examination (Fig. 94) confirmed that the corrosion in T61 sheets was exfoliation resulting from intergranular attack and only pitting in the T761 temper sheets.

These results demonstrate the superiority of the T761 temper over the T61 temper from the standpoint of resistance to exfoliation. The performance of the 7475-T61 sheet was about as expected and even though it did show some susceptibility, it is still better than what is to be expected of 7075-T6 sheet. Past experience has shown that in the thicker gauges (>0.125 in.) the majority of 7075-T6 sheet will show susceptibility to exfoliation to a greater degree than E-A.

C.1.3. 2124-T851 Plate

The EXCO test is recommended only for copper containing 7XXX series alloys and during development of the test it was shown that 4 or more days exposure is required to reveal susceptibility to exfoliation in 2XXX series alloys. Accordingly, a 6 day exposure period was used for the contract material. The spray test will reliably detect exfoliation susceptibility in 2XXX series alloys within one week exposure, but it too was lengthened to two weeks to ensure that a very slight degree of susceptibility would not be missed. Even with this prolonged exposure, all lots of 2124-T851 plate were fully resistant to exfoliation (Table LXIX).

C.2. Resistance to SCC - Smooth Specimens

C.2.1. 7049-T73 and 7175-T736 Forgings

C.2.1.1. Die Forgings

Results of stress corrosion tests on 7049-T73 and 7175-T736 die forgings in the longitudinal and long-transverse directions are shown in Table LXX. Neither alloy incurred any failure and the reduction in strength by corrosion was similar for both alloys.

The losses in strength of stressed specimens from the forgings less than 1-in. thick (S. Nos. 410693 and 410983) were somewhat high, approximately 50 per cent. The fractured faces of

these specimens were examined to determine whether incipient SCC was responsible for the high loss. The examination showed that the higher-than-normal reduction in strength resulted from short transgranular cracks emanating from sites of deep pitting corrosion and no evidence of intergranular SCC was detected.

Results of accelerated tests in the short-transverse direction are given in Table LXXXI. As regards the 30 day capability, alloy 7049-T73 is guaranteed at 45 ksi. At this stress, two of the 7049-T73 forgings, S. Nos. 410698 and 410700, failed in less than 30 days when tested with 0.125-in. specimens but survived 30 days when retested with 0.225-in. diameter specimens. Currently the procurement specifications do not stipulate the type or size of test specimen to be used. All of the 7175-T736 die forgings survived 30 days at the 35 ksi test stress required of this alloy and, in fact, only a single specimen failed in less than 30 days at 45 ksi. As such, all of the die forgings were considered to have met the required SCC performance.

With continued exposure to 84 days, most of the specimens of both alloys failed at the 45 and 35 ksi stresses. Representative specimens were examined metallographically to verify the nature of failure. Many of the specimens showed a mixture of transgranular and intergranular auxiliary cracks, but in all cases the extent of intergranular cracking was such that SCC was a probable cause of failure, (Fig. 95). Alloy 7049-T73 was not tested at 25 ksi, but it is likely that at this test stress it would exhibit a high degree of resistance to SCC, similar to that observed for 7175-T736.

The number of failures and the times to failure recorded in Table LXXXI for the 45 and 35 ksi test stresses are such that it is not obvious whether the two alloys are similar or if one has an SCC advantage. At both stresses the 7049-T73 forgings began to fail sooner, but incurred fewer total number of failures, than the 7175-T736 forgings. In order to resolve this, the cumulative per cent survival of forgings tested with a tensile specimen across the parting plane was compared using a procedure described by C. F. Lewis(37). Preparation of the data is shown in Part A of Table LXXII and a graphical comparison of the per cent survival is shown in Fig. 96. Part B of Table LXXII lists the expected life (mean failure time), estimated standard deviation and possible error for the two alloys. Based on this comparison it is concluded that the SCC resistance of the two alloys in these tests was not significantly different, but that the alternate immersion test was somewhat more variable for 7049-T73 than for 7175-T736. For the most part the alternate immersion tests of the two alloys were conducted concurrently, hence, the greater variability for 7049-T73 is most likely an alloy composition effect and not merely variations in separate alternate immersion runs.

It has been shown(38) that the correlation between SCC performance in the alternate immersion test and natural atmospheric

environments is not the same for all aluminum alloys. Thus far seacoast and industrial atmospheric tests on these forgings (Table LXXIII) have resulted in failure only for one 7049-T73 forging (S. No. 410698). These tests are of about one year duration and longer exposure is required to establish whether or not the atmospheric SCC performance of the two alloys differs significantly.

In summary, the resistance to SCC of 7049-T73 and 7175-T736 die forgings appears to be similar. Both alloys are markedly superior to other alloys such as 2014-T6, 7075-T6 and 7079-T6; but are less resistant than 7075-T73. They do, however, have a strength advantage over 7075-T73 die forgings.

Two side issues in this portion of the contract were: (a) the effect of specimen location for short transverse specimens from forgings made with conventional dies, and (b) the performance of specimens from forgings made in flat cover dies.

The forgings made in conventional dies were tested with short transverse specimens positioned 3/8 in. below the flash metal. Two shapes in each alloy were also tested with specimens positioned 3/16 in. below the flash (about as close to the forged surface as specimens could be taken) because the visual appearance of macroetched cross sections indicated a slightly more intense parting plane structure in this region. However, in three cases the results did not differ greatly with test location and in one case (S. No. 410693), the specimens closest to the flash were more resistant. While these data are not conclusive, they suggest that slight differences in the proximity of a short transverse specimen to the surface of the forging may not be as critical as expected. Forging geometry will limit how close a specimen can be positioned to the surface. For purposes of standardization, it would seem best to use a specimen location that would be possible for most forged shapes, something on the order of 3/8 to 5/8 in. below the flash.

Certain forged shapes are made with flat cover dies with the parting plane structure at the very base of the forging so that all or most of it will be removed during finish machining. Flat cover forgings in this program were tested with tensile specimens perpendicular to the parting plane (Fig. 29), but since they did not cross it, the grain structure in the gage length was transverse or long transverse rather than short transverse. The results show that these specimens were indeed more resistant than specimens taken across the parting plane. Hence, results obtained on flat cover forgings cannot be used to predict the performance of a forging in which a tensile stress can operate across the parting plane structure. An attempt was made to obtain a test across the parting plane flow of S. Nos. 410697 and 410705 through the use of C-rings. The results, however, indicate this test was no better, and perhaps even less critical, than the test with perpendicular tensile specimens.

C.2.1.2. Hand Forgings

The accelerated SCC data for hand forgings are given in Table LXXIV for alloy 7049-T73 and in Table LXXV for alloy 7175-T736. Short-transverse specimens are also being tested in seacoast and industrial atmospheres. Thus far no failure has occurred in the atmospheric tests, but they are only of 3 to 6 months duration.

Similar to the die forgings, hand forgings of both alloys had high resistance to SCC in the longitudinal and long-transverse directions with no failure occurring.

No short-transverse failure occurred during the first 30 days of test, hence, all hand forgings met the required SCC capability.

With continued exposure, both alloys had failures at the 45 and 35 ksi stresses. Metallographic examination showed a mixture of intergranular and transgranular auxiliary cracks in the failed specimens with intergranular cracking predominating so that all failures were considered to be SCC failures.

The majority of the 7049-T73 failures occurred at 45 ksi; whereas, for two of the 7175-T736 forgings (S. Nos. 410689 and 410986) most of the failures occurred at 35 ksi, which is somewhat unusual. The short-transverse grain flow characteristics will vary down the length of hand forgings (Fig. 33). Macroetched sections were obtained from all hand forgings prior to procuring specimens to ensure that all specimens had a short-transverse orientation. However, because specimens from hand forgings were used in sequential order, rather than being randomized, there is the possibility that some sets of specimens came from an area of more critical grain structures than did other sets.

Because these two alloys have some susceptibility to SCC, it might be expected that the greater reduction given to thinner forgings would increase the degree of grain directionality and have an adverse effect on resistance to SCC. However, the data obtained on the hand forgings do not indicate a significant effect from product thickness; though the hand forgings were somewhat more resistant than specimens from the highly directional parting plane area of die forgings.

In summary, tests on these particular eight hand forgings indicate that all forgings met the 30 day SCC capability claimed for the respective alloys and that the overall performance of the two alloys was similar.

C.2.2. 7475 Sheet

The 7475 sheet exhibited a high degree of resistance to SCC in the long-transverse direction for both the T61 and T761

tempers. No failure occurred even for the highly stressed preform specimen (Table LXXVI).

In the aggressive alternate immersion environment, an appreciable amount of general corrosion occurred, as indicated by the reduction in tensile strength. When exposed unstressed the T761 temper incurred somewhat less loss in strength than did the T61 specimens.

No atmospheric tests were made on the 7475 sheet.

C.2.3. 2124-T851 Plate

All of the 2124-T851 plates tested had high resistance to SCC in the longitudinal and long-transverse directions, with no failure occurring during the 84 day test (Table LXVII).

All six plates tested incurred some short-transverse failures during the 84 day test (Table LXXVII). Fractured specimens, representative of each stress at which failure occurred, were examined metallographically. All specimens from the 1.75, 2.00 and 2.04 inch plates showed evidence of intergranular SCC (Fig. 97). However, failures from the 2.5 and 4.5-in. plates that occurred after 60 days appeared to result primarily from tensile overload due to deep pitting.

The better performance of the thicker plate was also evidenced by higher per cent survival and longer times to failure (Table LXXVII and Fig. 98). The four plates thicker than 2 in. passed the SCC requirement of 30 days at 50 per cent GYS. The 1.75 and 2.00-in. thick plates each had one failure in less than 30 days at 50 per cent GYS, but survived for more than 30 days when retested using 0.225-in. diameter specimens. This effect of plate thickness has been observed on other lots of 2124-T851 and is the reason why Alcoa currently does not guarantee the SCC capability of plate less than 2.0-in. thick.

Performance at a stress of 58 per cent GYS (32.5 ksi) was essentially the same as at 50 per cent GYS (28 ksi), but results indicate rather definitely that 2124-T851 plate would not consistently survive 30 days exposure to alternate immersion at a stress of 75 per cent GYS (42 ksi).

Preliminary results in the seacoast atmosphere (Table LXXVII) are tending to follow the trend observed in the accelerated test. The 1.75, 2.00 and 2.04-in. plates have all failed at 75 per cent YS within six months as compared with no failure to date for the 2.5 and 4.5-in. plates. Thus far no failure has occurred in the industrial atmosphere. A better performance in industrial atmosphere than in seacoast atmosphere is consistent with the general experience on Al-Cu alloys.

C.3. Resistance to SCC - Precracked Specimens

The various items tested with DCB tensile precracked specimens are listed in Table LXXVIII, along with the crack lengths measured at the end of test, and the results of metallographic examination to determine whether crack extension in the environment was caused by intergranular SCC. Although the crack lengths on the side of the specimens were measured periodically during the course of the test, it was concluded for various reasons (discussed later) that the results did not justify an attempt to quantitatively define SCC susceptibility by plots of crack length versus time of exposure and crack velocity versus stress intensity. Hence, the data have been interpreted qualitatively to compare: (a) the relative SCC performance of the various products and alloys and (b) trends established by the DCB specimen with those obtained with smooth tensile specimens.

C.3.1. 7049-T73 and 7175-T736 Forgings

Because of the forging geometry (Fig. 34), the DCB specimens from the die forgings were only 9/16 in. high rather than the standard 1 in. height. When the specimens were precracked in tension and loaded to pop-in, there appeared to be some plastic yielding in the specimen arms for 7049-T73 and obvious yielding for the 7175-T736 specimens, which were loaded to a value about 30 per cent higher because of the higher toughness of 7175-T736.

In addition, examination of the fracture faces after completion of the test showed considerable bowing of the crack front and faster propagation at the center of the specimen than at the edge for specimens from both die and hand forgings, (see total crack length edge versus center in Table LXXVIII and Fig. 99). Consequently it was concluded from previous results[26] that calculation of residual stress intensity by the compliance formula would be in error.

All specimens from the forgings incurred slight crack growth in the environment, the initial growth being detected after 2 days exposure for die forging specimens and 8 days exposure for hand forging specimens. Somewhat more growth occurred for 7175-T736 die forging specimens than for specimens from 7175-T736 hand forgings and 7049-T73 die and hand forgings, which were all similar (Table LXXVIII). Metallographic examination confirmed that in all cases the environmental growth was caused by SCC. An example of the intergranular nature of the crack growth is shown in Fig. 99.

The more directional parting plane grain flow near the flash metal did not influence crack growth in specimens from die forgings. Specimens from the flange of the die forgings performed about the same as those from the web. Also there was no appreciable difference in crack growth on the side of the flange specimen closest to the parting plane flash compared with growth on the side away from the flash.

In summary, the precracked specimen data ranked the two alloys in the same general manner as did smooth specimens. Both alloys were similar to each other, somewhat less resistant than 7075-T7351 (which would incur very little growth in such tests) and markedly superior to 7075-T651 (which incurs similar crack growth in a week of exposure and about 0.7-in. growth in 30 days).

C.3.2. 2124-T851 Plate

The DCB specimen from the 1-3/4-in. 2124-T851 plate incurred about 1/4 in. of crack growth during the 30 day test as a result of intergranular SCC. Although the crack front was bowed, the environment growth at the edge and center of this specimen was similar, (Fig. 100). The fracture faces illustrated in Fig. 100 were chemically cleaned prior to photographing but still show that considerable corrosion had occurred tending to obliterate contrasting appearance of the precrack and environment growth regions. Consequently, there may have been wedging from buildup of corrosion product preventing a decrease in stress-intensity as the crack propagated. Assuming no corrosion-product wedging (which is probably incorrect) a "Region II" plateau stress corrosion crack velocity of 3.3×10^{-4} in./hr (4.6×10^{-9} m/sec) was calculated for stress intensities of 23 to 33 ksi$\sqrt{\text{in.}}$, which is somewhat faster than the value of 3×10^{-5} in./hr (4.2×10^{-10} m/sec) at 24 ksi$\sqrt{\text{in.}}$ noted in similar tests of 7075-T7351 plate.

DCB specimens from the four thicker (2.5 to 5.5 in.) 2124-T851 plate showed very little environmental growth (Fig. 100) and metallographic examination showed the environmental extension of the precrack was strictly transgranular, indistinguishable from the precrack. The intergranular growth in the 1.75-in. plate and the transgranular growth in the 5.5-in. plate are compared in Figs. 101 and 102. Residual stress-intensity on the DCB specimens from the thicker plates were of the order of 33 ksi$\sqrt{\text{in.}}$, but because no intergranular SCC occurred it does not seem relevant to calculate a crack velocity.

In comparison with smooth specimen tests, both types of data showed an effect of plate thickness, the 1.75-in. plate being significantly less resistant to SCC than the thicker plate. Results on thicker plate differed slightly, the DCB specimen showing no SCC whatsoever, whereas the smooth 1/8-in. dia. specimen detected some SCC susceptibility for the 2.5-in. plate at a stress of 75 per cent YS, but not for the 4.5-in. plate.

SECTION VI

SUMMARY AND CONCLUSIONS

Based on the results of tests of commercially produced die and hand forgings, sheet and plate that met the requirements for composition and tensile properties in applicable Federal, Military and Tentative specifications, the following conclusions seem warranted concerning the mechanical properties, including fracture toughness and fatigue, fatigue crack propagation rates and resistance to stress-corrosion and exfoliation of 7049-T73 and 7175-T736 die and hand forgings, 7475-T61 and T761 sheet and 2124-T851 plate:

A. Mechanical Properties

A.1. Tensile, Compressive, Shear and Bearing

1. Some apparent differences were indicated among the tensile and compressive properties of the 7049-T73 die forgings and 2124-T851 plate fabricated by different producers.

2. Ratios among the tensile, compressive, shear and bearing properties of the forging, sheet and plate samples and from supplemental data are shown in Tables XV through XXI.

3. Ratio values used in computing the design values from the specified tensile properties of the respective thickness ranges of each alloy and product are shown in Tables XXIX through XXXIV.

4. Computed design values for each alloy and product are shown in Tables XXXV through XLI.

5. The modulus of elasticity of each product is 4 or 5 per cent higher in compression than in tension; there are only small, if any, differences with respect to direction (L, LT and ST). The average modulus values for each product, in all directions, are:

Alloy	Product	Modulus, 10^3 ksi	
		Tensile	Compressive
7049 & 7175	Die Forging	10.2	10.7
7049 & 7175	Hand Forging	10.2	10.6
7475	Sheet	10.0	10.5
2124	Plate	10.4	10.9

6. Typical stress-strain and compressive tangent-modulus curves are shown in Figs. 35 through 41.

A.2. Fracture Toughness

1. The average values of plane-strain stress-intensity factor, K_{Ic} (ksi$\sqrt{\text{in.}}$), at 5 per cent secant offset using compact-tension specimens are as follows:

Alloy and Temper	Product	Orientation L-T or L-S	T-L	S-L
7049-T73	Die Forging	31.2	--	22.5
	Hand Forging	29.8	20.9	19.9
7175-T736	Die Forging	35.1*	--	25.8
	Hand Forging	34.6*	26.9	23.3
2124-T851	Plate (Producer A&C)+	29.6	24.3	22.2

* Average of all K_Q values considered meaningful; not all values are technically valid.

\+ Values for plate from Producer B were lower, and not representative of high toughness product.

2. The average critical stress-intensity factor, K_c, derived for bare 7475-T61 and T761 sheet and Alclad 7475-T61 sheet from tests of 16-in.-wide panels tested without anti-buckling guides are:

Alloy and Temper	Orientation L-T Visual	L-T Compliance	T-L Visual	T-L Compliance
7475-T61	98.9	105.0	92.0	96.4
7475-T761	106.0	119.4	101.4	112.5
Alc7475-T61	87.4	93.6	85.7	94.4

These illustrate that the toughness of 7475 sheet is well above that of 7075-T6 sheet and approaches that of 2024-T3 sheet.

A.3. Axial Stress Fatigue

1. The results of the smooth and notched (K_t=3) axial-stress fatigue tests (R=0.0) are plotted in Figs. 53 through 66 and summarized in Tables LVI through LXI. Except for 7175-T736 forgings showing longer fatigue lives at the low stress level, the fatigue lives of both 7049-T73 and 7175-T73 forgings are about the same. In general, the 7049-T73 and 7175-T736 forgings showed longer lives than 7075-T7352 hand forgings. At the high stress level, 7475-T61 has longer fatigue lives than does 7475-T761. Both 7475-T61 and T761 have fatigue lives that are equal to or longer than those of 2024-T3 and 7075-T6 sheet. Alloy 2124-T851 plate has fatigue lives that are about the same as those of 2024-T851 plate at the high stress level; at the low stress level, the lives are shorter.

2. The salt fog environment lowers the fatigue strength of all products, with the greatest reduction occurring for the smooth specimens at the lower stresses.

3. The detrimental effect of the salt environment on fatigue strength of 7475-T61 and T761 sheet is greater for the thinner sheet.

B. Fatigue Crack Propagation

1. In most cases, there was little influence of orientation in fatigue crack growth rate; rates determined for longitudinal (L-T) or short transverse (S-T or S-L) specimen are equivalent to those obtained for long-transverse (T-L) specimens.

2. The rates of fatigue crack growth determined in dry air for longitudinal (L-T) and long transverse (T-L) specimens from 7175-T736 hand forgings are equivalent to those 7075-T7352 specimens tested in ambient air (relative humidity = 5-50 per cent).

3. At the higher stress intensities, the fatigue crack growth of T-L specimens is slower for alloy 7175-T736 than for 7049-T73 hand forgings in all environments; however, results for L-T specimens of the two forgings were equivalent.

4. The rates of fatigue crack growth for 7475-T61 and 7475-T761 sheet tested in dry air are essentially equivalent to those of Alclad 7475-T61 sheet in relatively dry air.

5. The humid air and salt fog environments increase the rate of fatigue crack propagation in 7475-T61 and T761 sheet by factors of three and four, respectively.

6. Fatigue crack growth is slower in alloy 2124-T851 than in alloy 2024-T851 plate.

7. For both hand forging alloys, comparable fatigue crack growth rates were obtained with center notch and compact tension specimens.

8. The rates of fatigue crack growth determined for the sheet, plate and hand forgings generally differ by no more than a factor of 4 in equivalent environments. The effect of salt fog environment on fatigue crack growth rate seemed to be greater for the 7475 sheet specimens than for the specimens from 7049 and 7175 hand forgings or 2124 plate. However, this was probably a result of the fact that the 7475 specimens were much thinner.

C. Corrosion Characteristics

1. Accelerated tests showed complete freedom from exfoliation for the 2124-T851 plate and the 7475-T761 sheet. The 7175-T736 forgings were also highly resistant, with only one of fifteen test specimens showing very slight exfoliation. The

7049-T73 forgings showed a slight tendency to be susceptible to exfoliation; but the majority were free of exfoliation. All of the 7475-T61 sheet material showed some visual exfoliation, but only one of the twelve lots of sheet showed visual exfoliation greater than the least degree (Exfoliation - A) in the ASTM rating system.

2. All of the materials were resistant to stress-corrosion cracking when stressed to 75 per cent YS in the longitudinal or long transverse grain directions.

3. The resistance to SCC in the short transverse grain direction of all the materials was representative of the respective alloys and tempers. All items met the specified 30 day capability in the alternate immersion test when tested with 0.125-in. dia tensile specimens with the exception of two of the 7049-T73 die forgings (one by Producer A and one by Producer B) and the two thinnest 2124-T851 plates (one by Producer A and one by Producer C). These latter four items met the 30 day capability when tested with 0.225-in. dia specimens.

4. In accelerated tests, the short-transverse SCC performances of 7049-T73 and 7175-T736 forgings were quite similar as regards the level of stress causing failure and mean failure times. Both alloys were resistant at stresses of 25 ksi or slightly higher, but were not immune at a stress of 45 ksi. Because of a less directional grain structure, hand forgings of both alloys were somewhat more resistant than die forgings. Thus far, the only atmospheric failures have been from one 7049-T73 die forging in seacoast atmosphere.

5. Short-transverse SCC performance of the 2124-T851 plate was in agreement with prior experience with regard to the effect of plate thickness. Plates 2-1/2-in. or thicker were resistant at a stress of 50 per cent YS, but showed some susceptibility at higher stresses. The thinner plates were less resistant, which is already corroborated by results of tests in seacoast atmosphere.

6. The general trends and comparisons obtained from tests of precracked DCB specimens from 7049-T73 and 7175-T736 forgings and 2124-T851 plate were similar to those obtained from tests with smooth tensile specimens. However, for various reasons the results did not permit a valid quantitative analysis of crack velocity vs stress intensity.

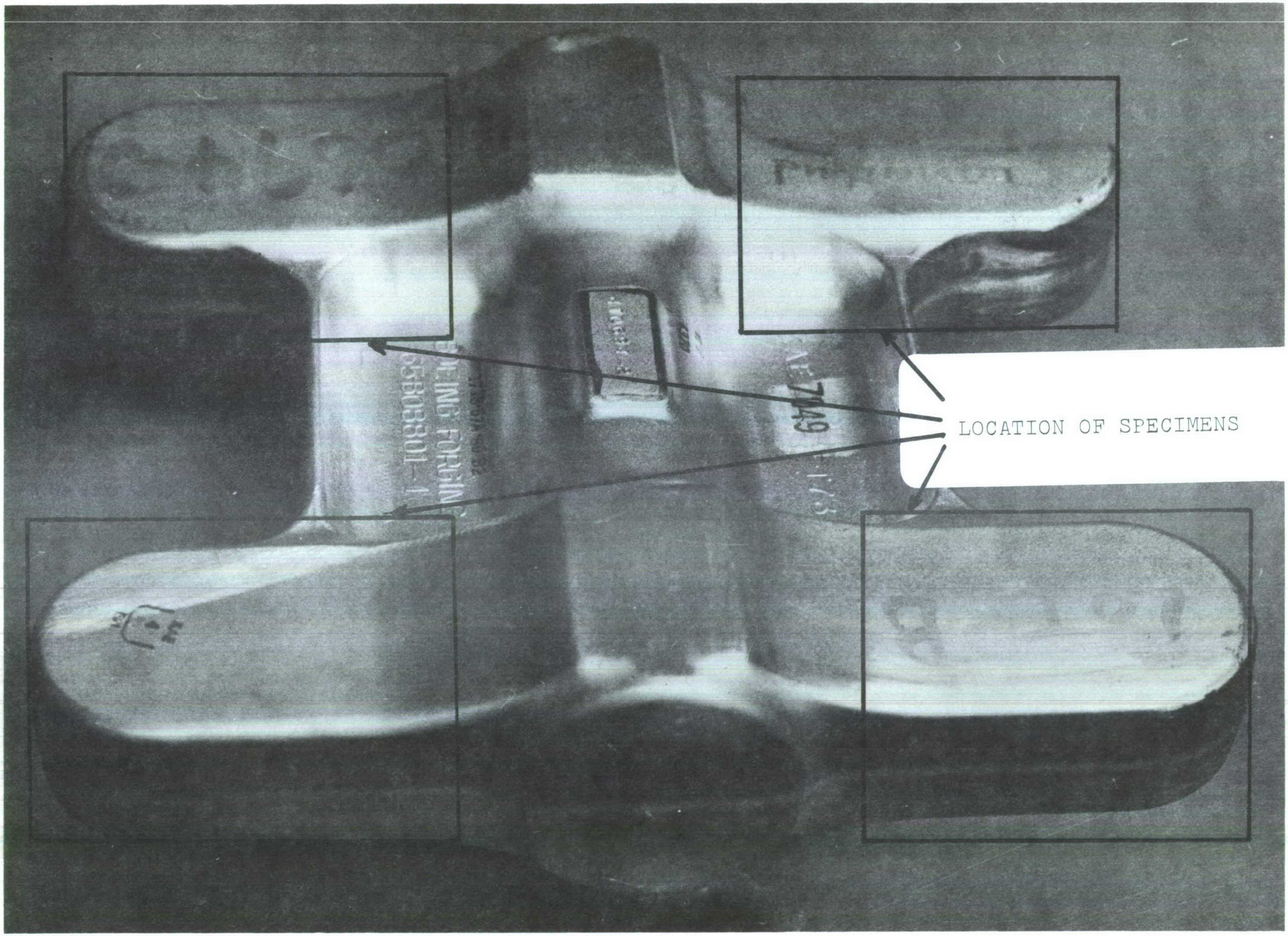


FIG. 1 7049-T73 DIE FORGING
DIE NO. B5786 (SAMPLE NUMBER 410694)

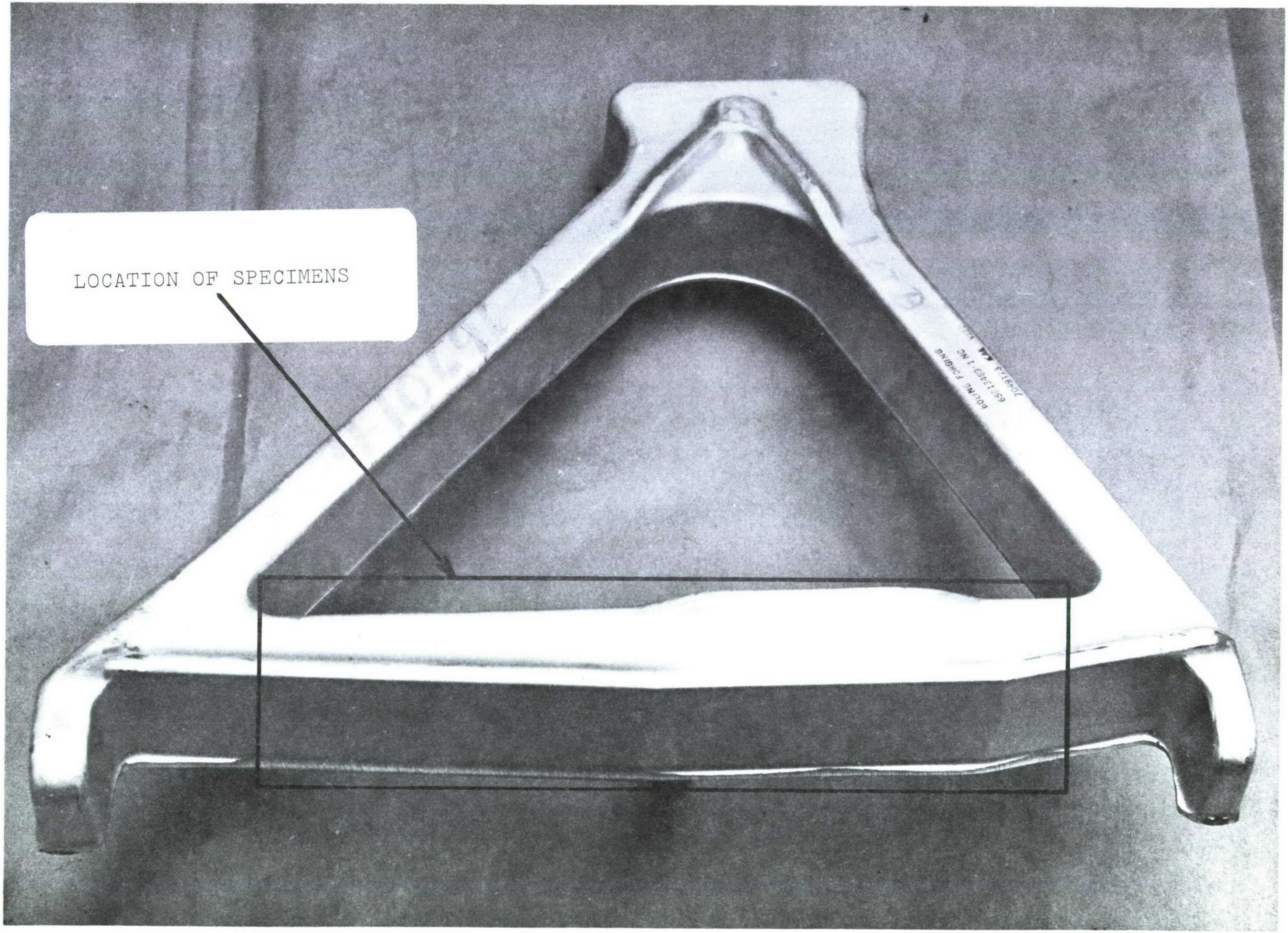


FIG. 2 7049-T73 DIE FORGING
DIE NO. B6204 (SAMPLE NUMBER 410696)

Fig. 2

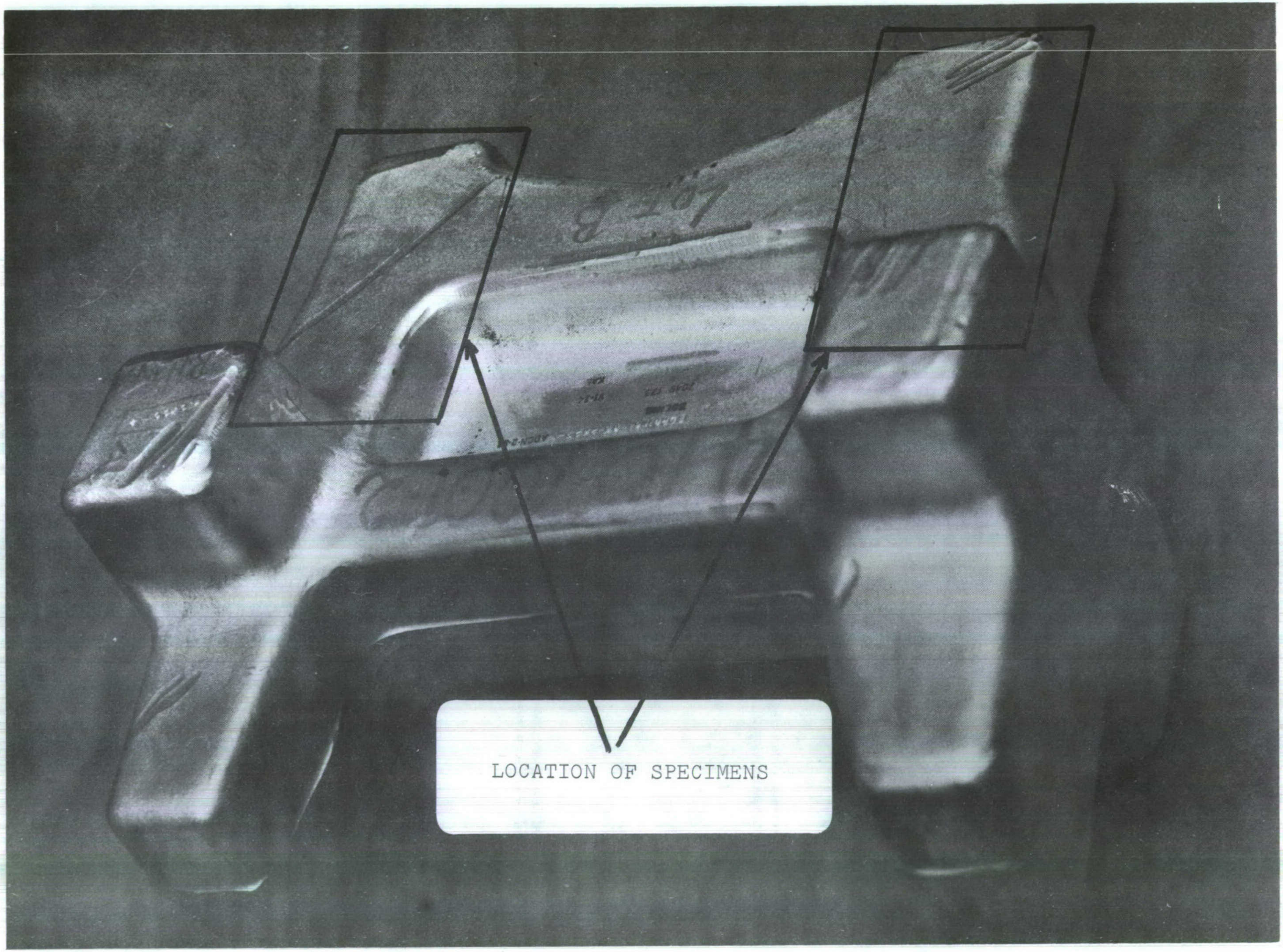


FIG. 3 7049-T73 DIE FORGING
DIE NO. B2362 (SAMPLE NUMBER 410700)

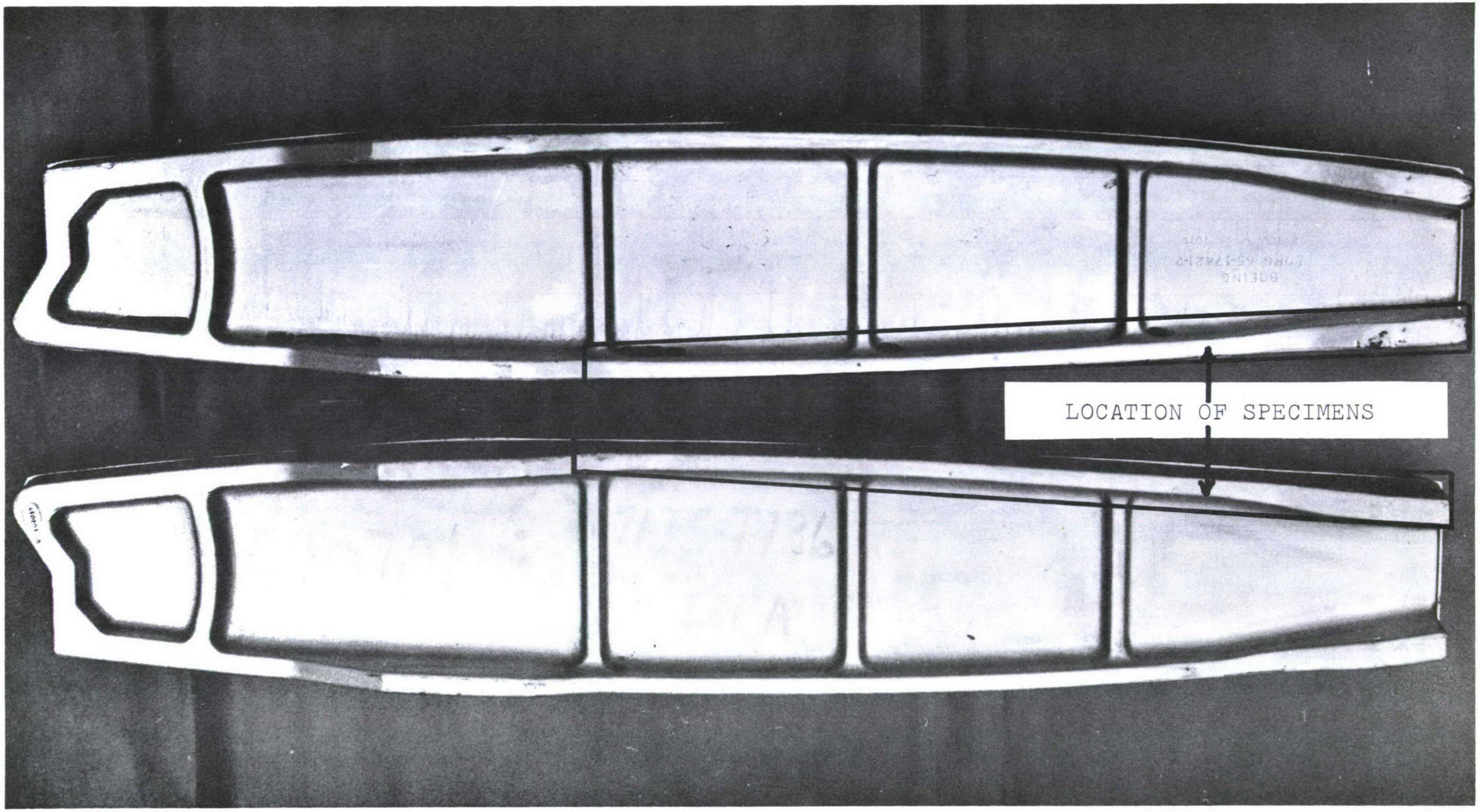


FIG. 4 7049-T73 AND 7175-T736 DIE FORGING
DIE NO. 9078 (7049-T73 SAMPLE NUMBER 410693, 7175-T736
SAMPLE NUMBER 410983)

FIG. 4

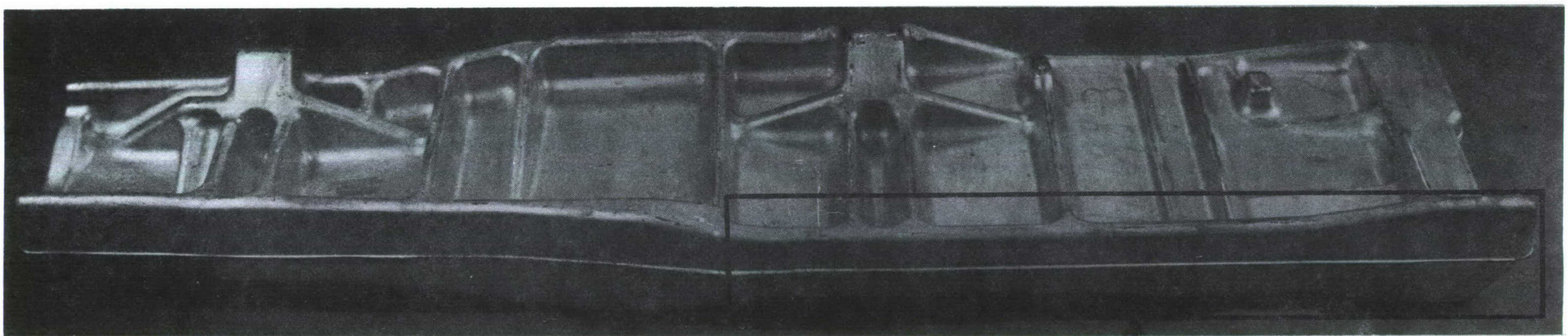


FIG. 5 **7049-T73 AND 7175-T736 DIE FORGING DIE NO. 15789 (7049-T73 SAMPLE NUMBER 410698, 7175-T736 SAMPLE NUMBER 410699)**

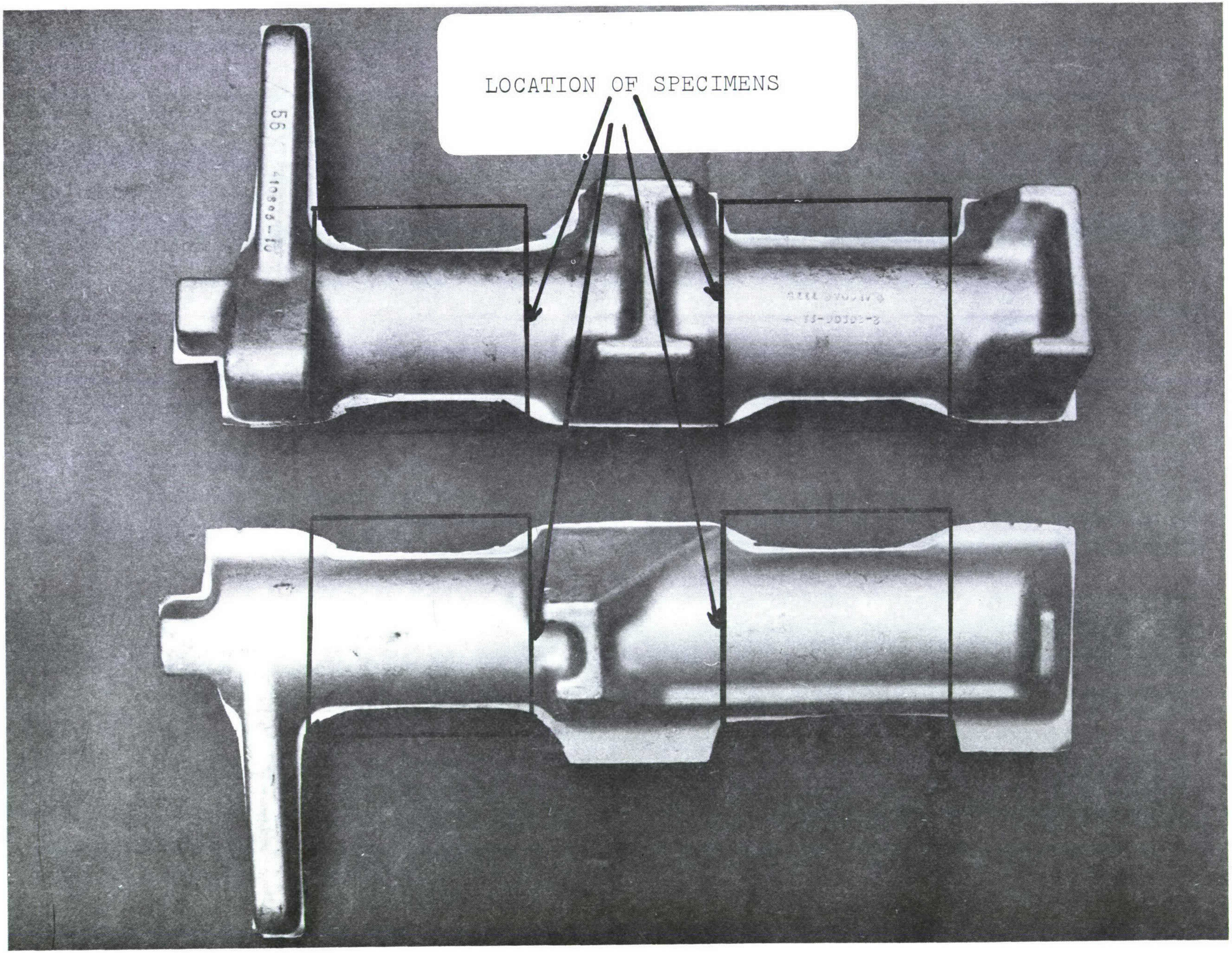


FIG. 6 7049-T73 AND 7175-T736 DIE FORGING
DIE NO. 40006 (7049-T73 SAMPLE NUMBER 410695, 7175-T736 SAMPLE NUMBER 410984)

Fig. 6

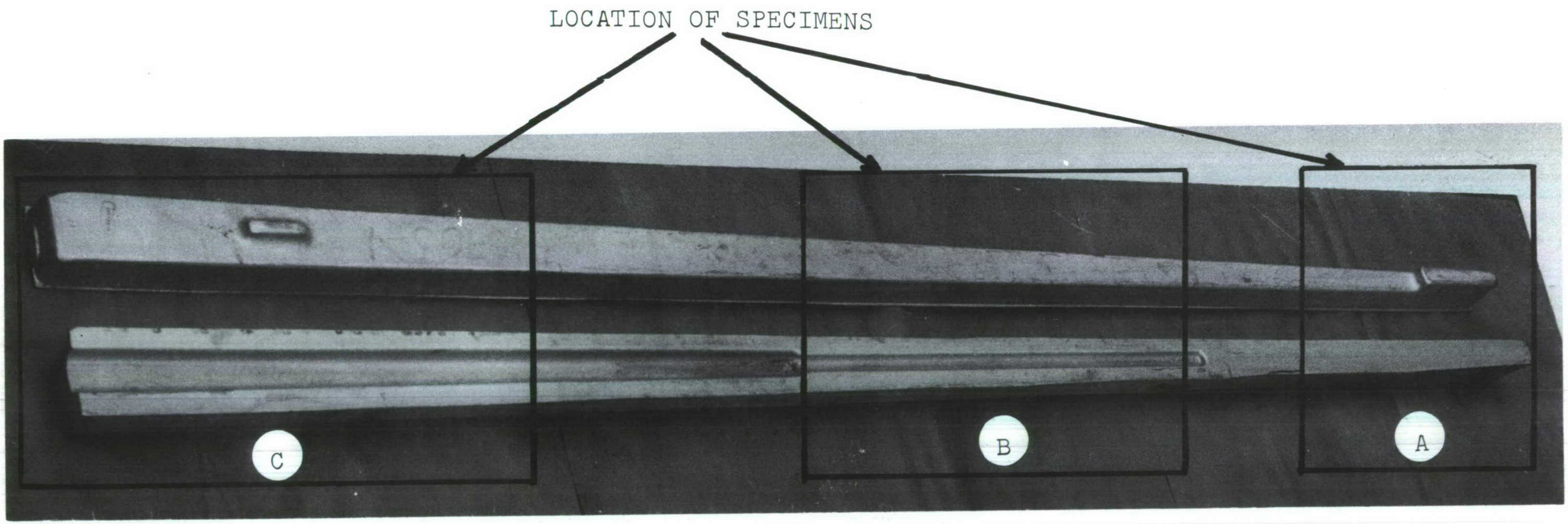


FIG. 7 7049-T73 AND 7175-T736 DIE FORGING
DIE NO. 40005 (7049-T73 SAMPLE NUMBER 410697, 7175-T736
SAMPLE NUMBER 410705)

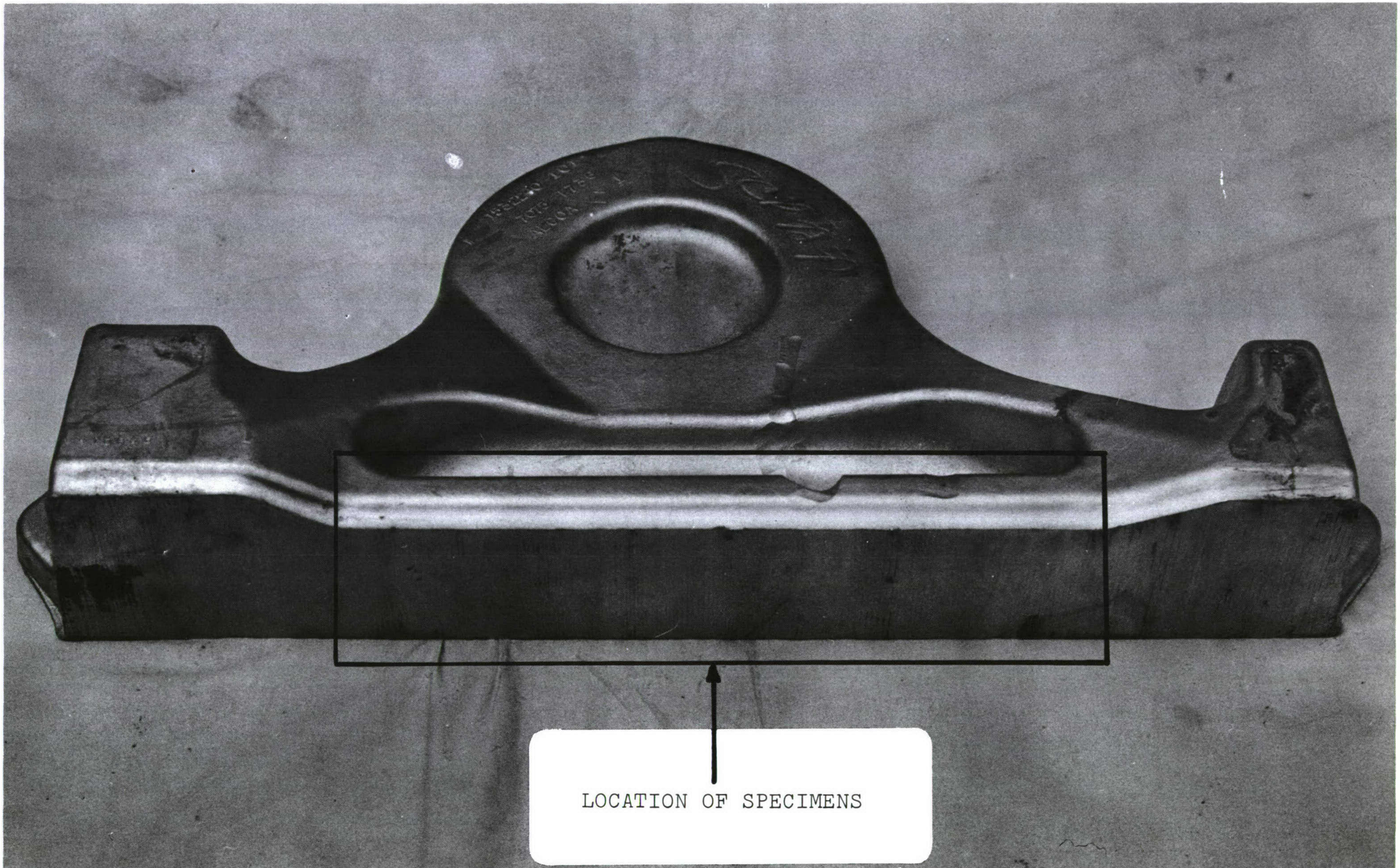


FIG. 8 7175-T736 DIE FORGING
DIE NO. F17961 (SAMPLE NUMBER 410704)

Fig. 8

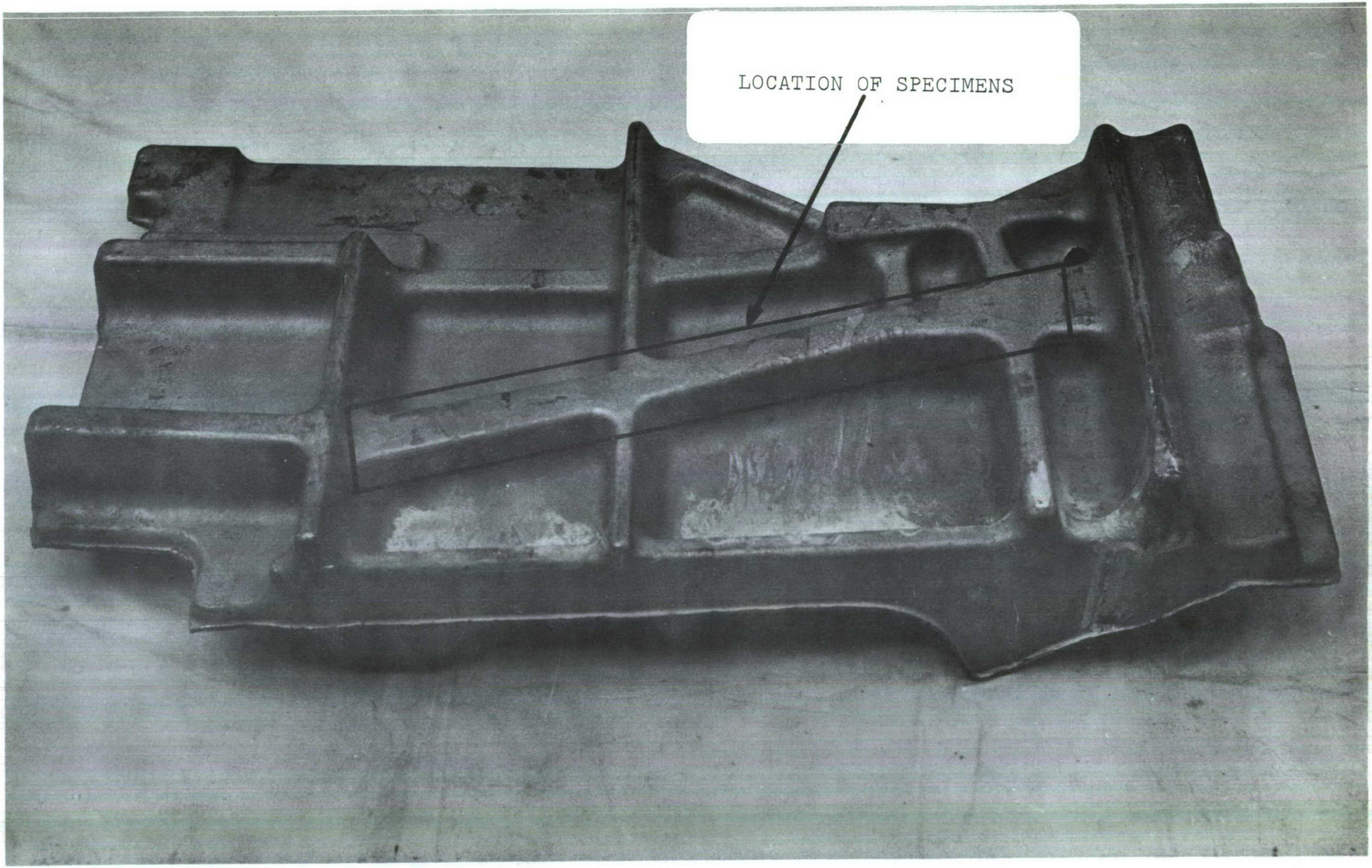
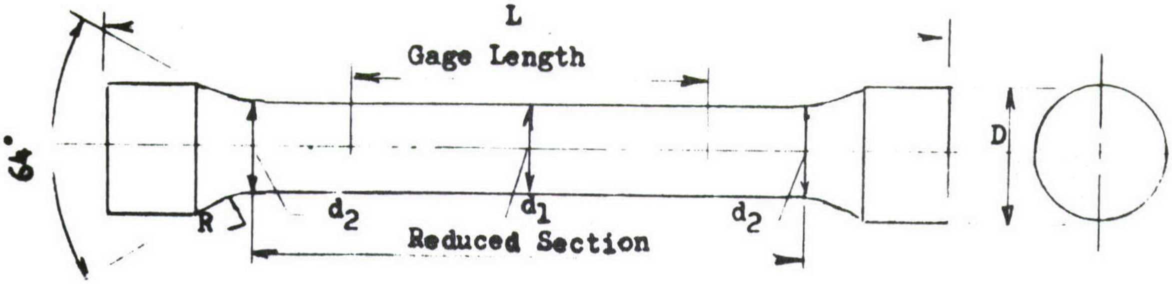
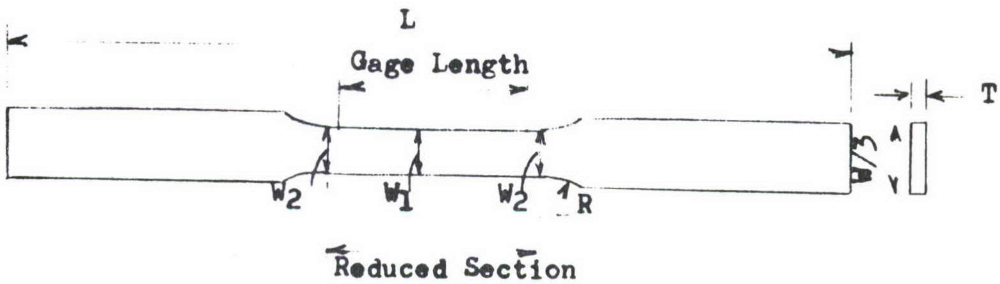


FIG. 9 7175-T736 DIE FORGING
DIE NO. F17976 (SAMPLE NUMBER 410706)



Diameter, in. d_1	d_2	Gage Length, in	Reduced Section Length, in	Radius(R) in.	Diameter (D), in.	Length (L), in.
0.500±0.005	$d_1 + \frac{0.005}{0.003}$	2.000±0.002	3-1/8	3/8	3/4	4-3/4
0.357±0.004	$d_1 + \frac{0.004}{0.003}$	1.400±0.002	2-15/64	17/64	17/32	3-3/8
0.250±0.003	$d_1 + \frac{0.002}{0.001}$	1.000±0.002	1-9/16	3/16	3/8	2-3/8
0.160±0.002	$d_1 + \frac{0.002}{0.001}$	0.640±0.002	1	0.120	15/64	1-1/2

Tapered-Seat Tensile Specimens

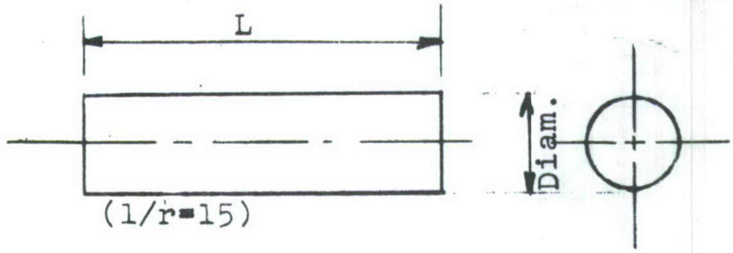


Width, in. W_1	W_2	W_3	Gage Length, in.	Section Length, in	Radius(R), in.	Thickness, (T), in.	Length(L) in.
0.500±0.010	$W_1 + \frac{0.005}{0.003}$	3/4	2.000±0.002	2-1/4	7/8	≈0.499	9 Min.
0.250±0.002	$W_1 + \frac{0.003}{0.002}$	3/8	1.000±0.002	1-1/4	3/8	≈0.250	4 Min.
0.125±0.001	$W_1 + \frac{0.0015}{0.001}$	3/16	0.500±0.002	5/8	3/16	≈0.125	2-1/4Min.

Sheet-Type Specimens

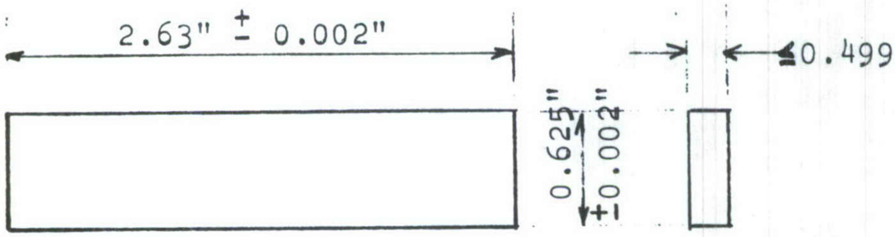
Fig. 10 General Dimensions of Tensile Specimens

Fig. 10

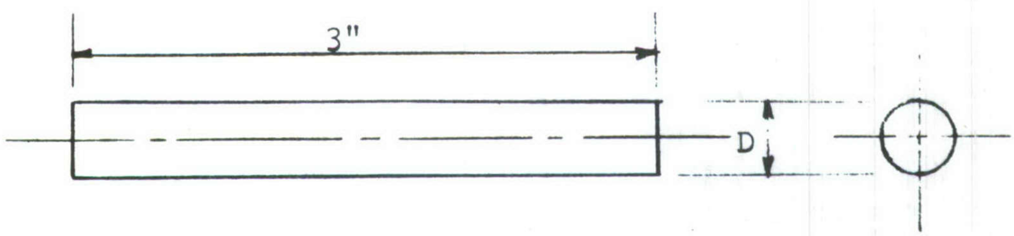


Nominal Diameter, in.	Diameter, in.	L, in.
1/2	0.498 / 0.495	1-7/8±1/32
3/4	0.7515 / 0.7495	3-1/2±1/32

Round Compressive Specimens



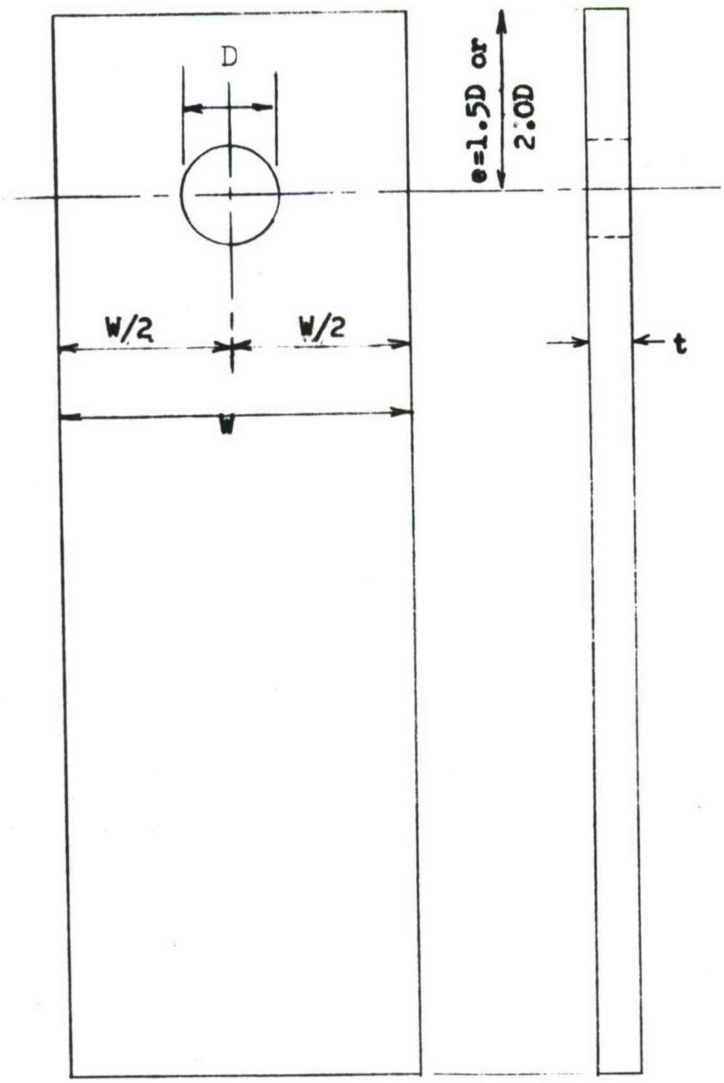
Sheet-Type Compressive Specimens



Nominal Diameter	D, in.
3/16	0.1865 / 0.1855
3/8	0.3730 / 0.3720

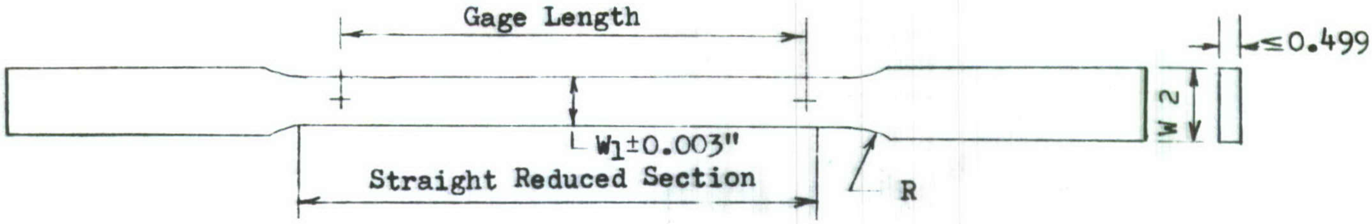
Shear Specimen

Fig. 11 General Dimensions of Compressive and Shear Specimens



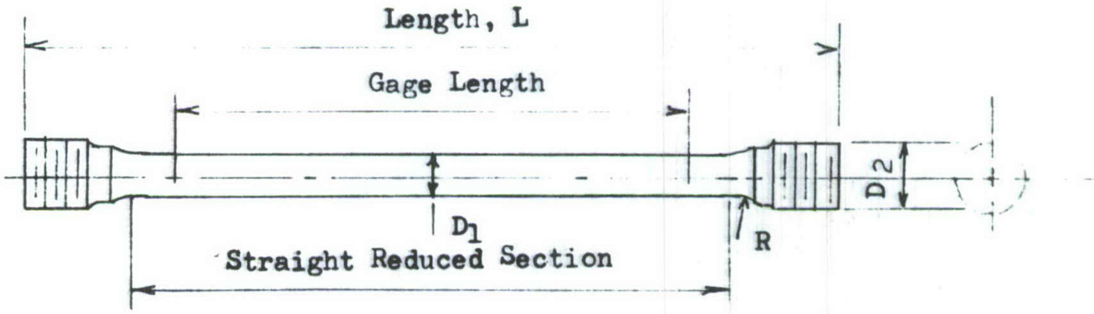
Specimen Thickness, in. t	Pin Hole Diameter, in. D	Width, in. W
0.094	4t	1.500±0.004
0.125 to 0.249	0.500	2.000±0.004

Fig. 12 General Dimensions of Bearing Specimens



Width, in.		Gage Length, in.	Reduced Section Length, in.	Radius (R), in.
W_1	W_2			
0.500 ± 0.003	3/4	3.000 ± 0.002	4	7/8

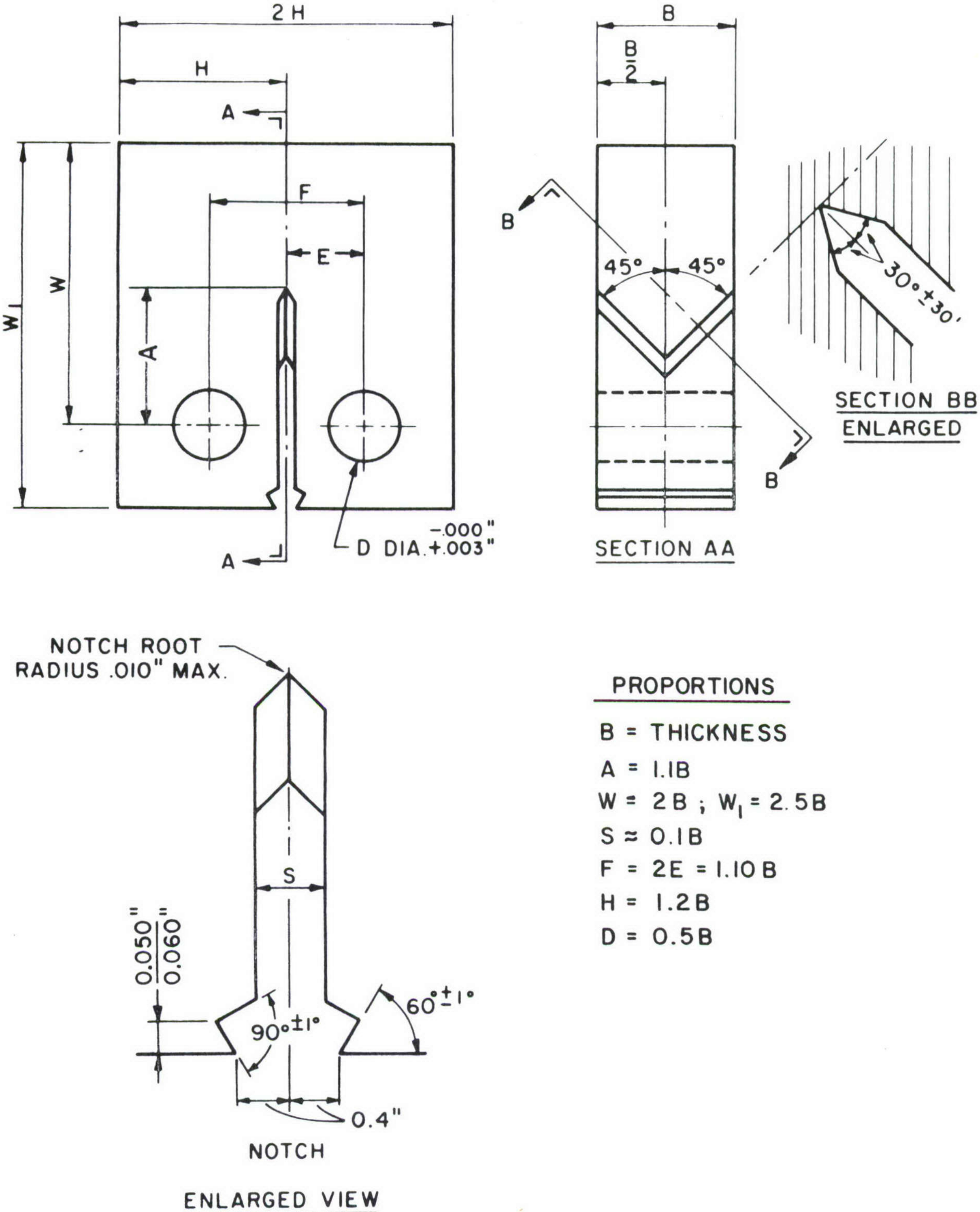
Sheet-Type Specimens



Diameter, in.		Gage Length, in.	Reduced Section Length, in.	Radius(R), in.	Length (L), in.
D_1	D_2				
0.500 ±0.003	3/4	3.000 ± 0.002	4	5/8	6-1/2
0.250 ±0.003	3/8	1.000 ± 0.002	1-9/16	3/16	2-3/8
0.160 ±0.002	15/64	0.640 ± 0.002	1	0.20	1-1/2
0.375 ±0.003	9/16	2.000 ± 0.002	2-3/4	≥ D_1	5

Round Specimens

Fig. 13 General Dimensions of Tensile Specimens
For Modulus and Stress-Strain Tests



PROPORTIONS

B = THICKNESS
A = 1.1B
W = 2B ; W_1 = 2.5B
S ≈ 0.1B
F = 2E = 1.10B
H = 1.2B
D = 0.5B

Fig. 14 **COMPACT TENSION FRACTURE TOUGHNESS SPECIMEN**

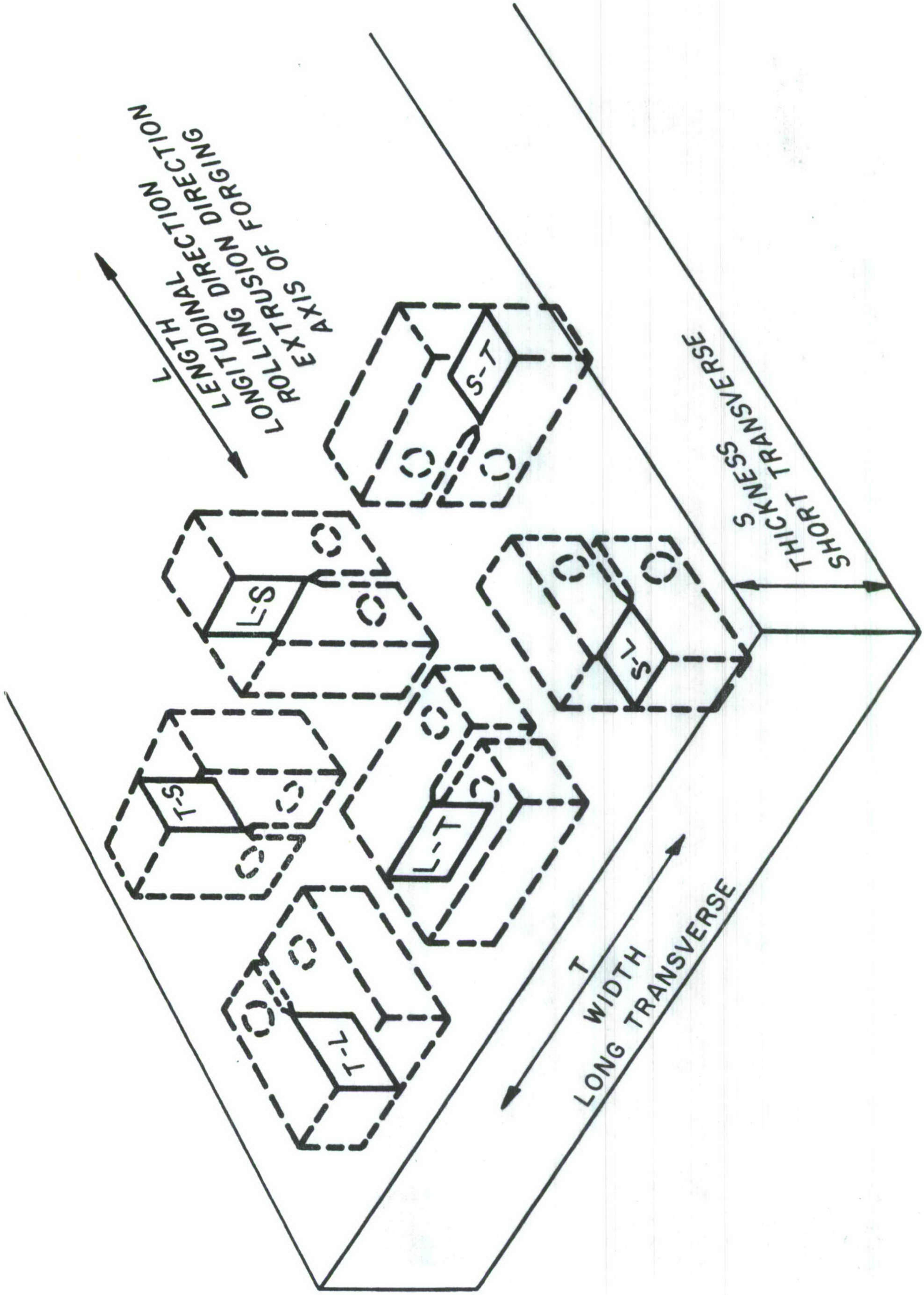


Fig. 15 FRACTURE SPECIMEN ORIENTATIONS

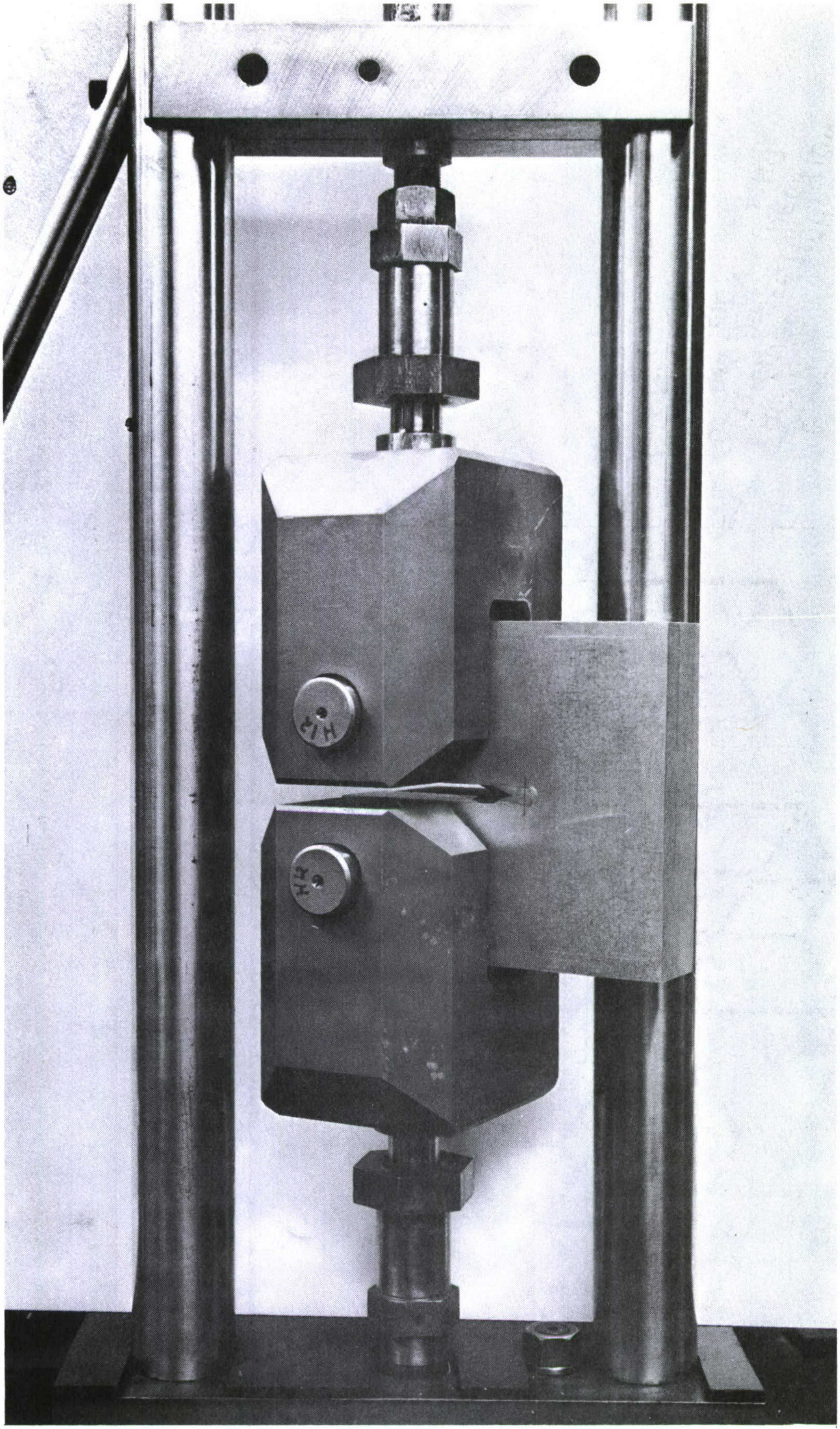


Fig. 16 Set Up for Fatigue Cracking Compact Tension Fracture Toughness Specimens

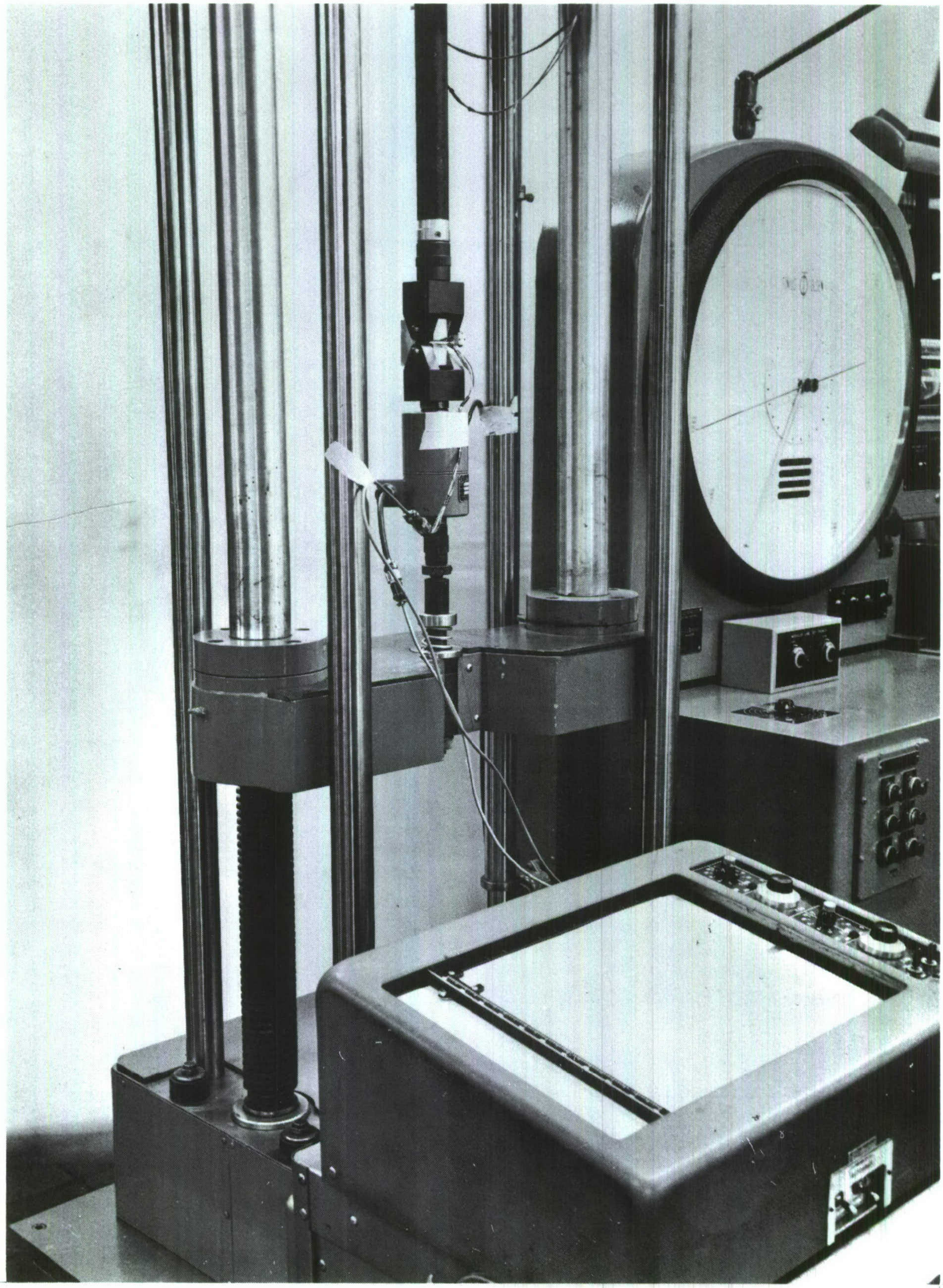
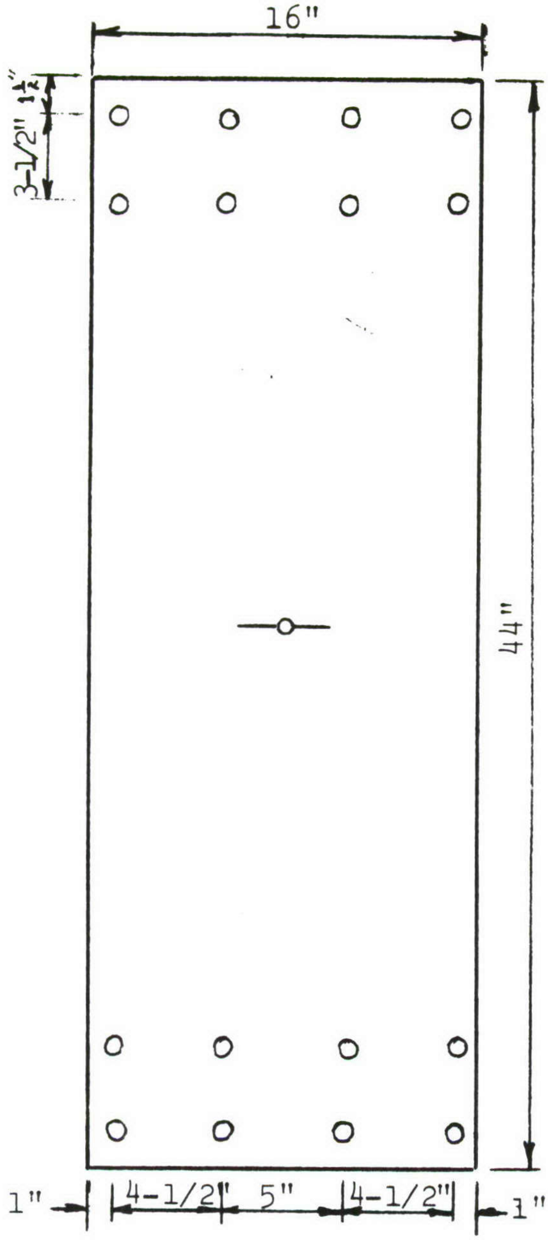
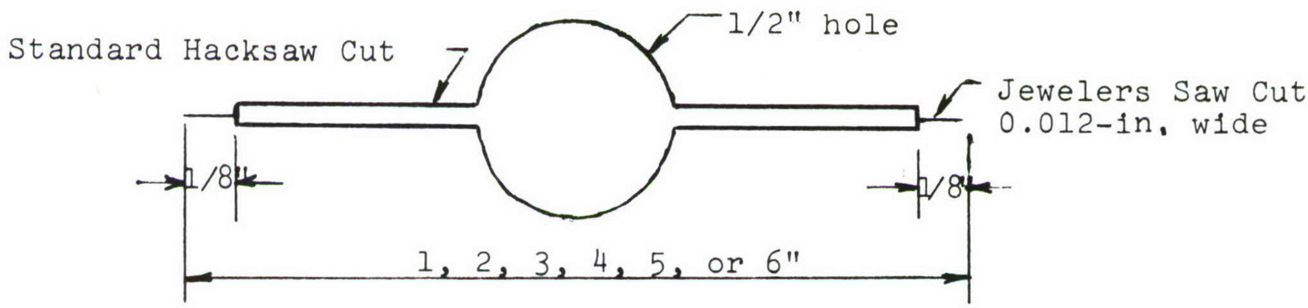


Fig. 17 Setup for Compact Tension Fracture Toughness Testing





DETAIL OF SLOT

Fig. 18 - Center Slotted Fracture-Toughness Panels.

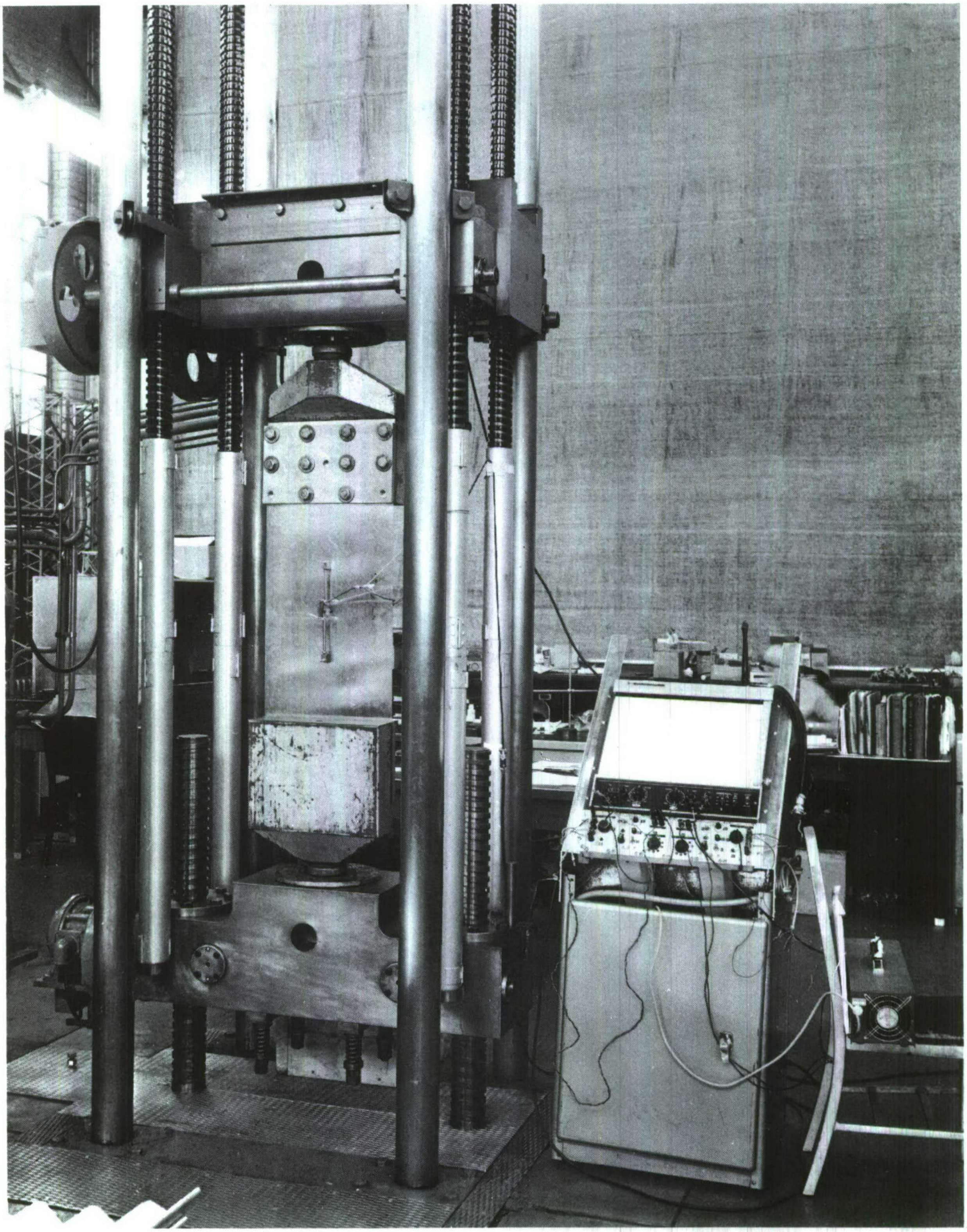


Fig. 19 Setup for 16-in. Wide Center-Slot Fracture Toughness Testing

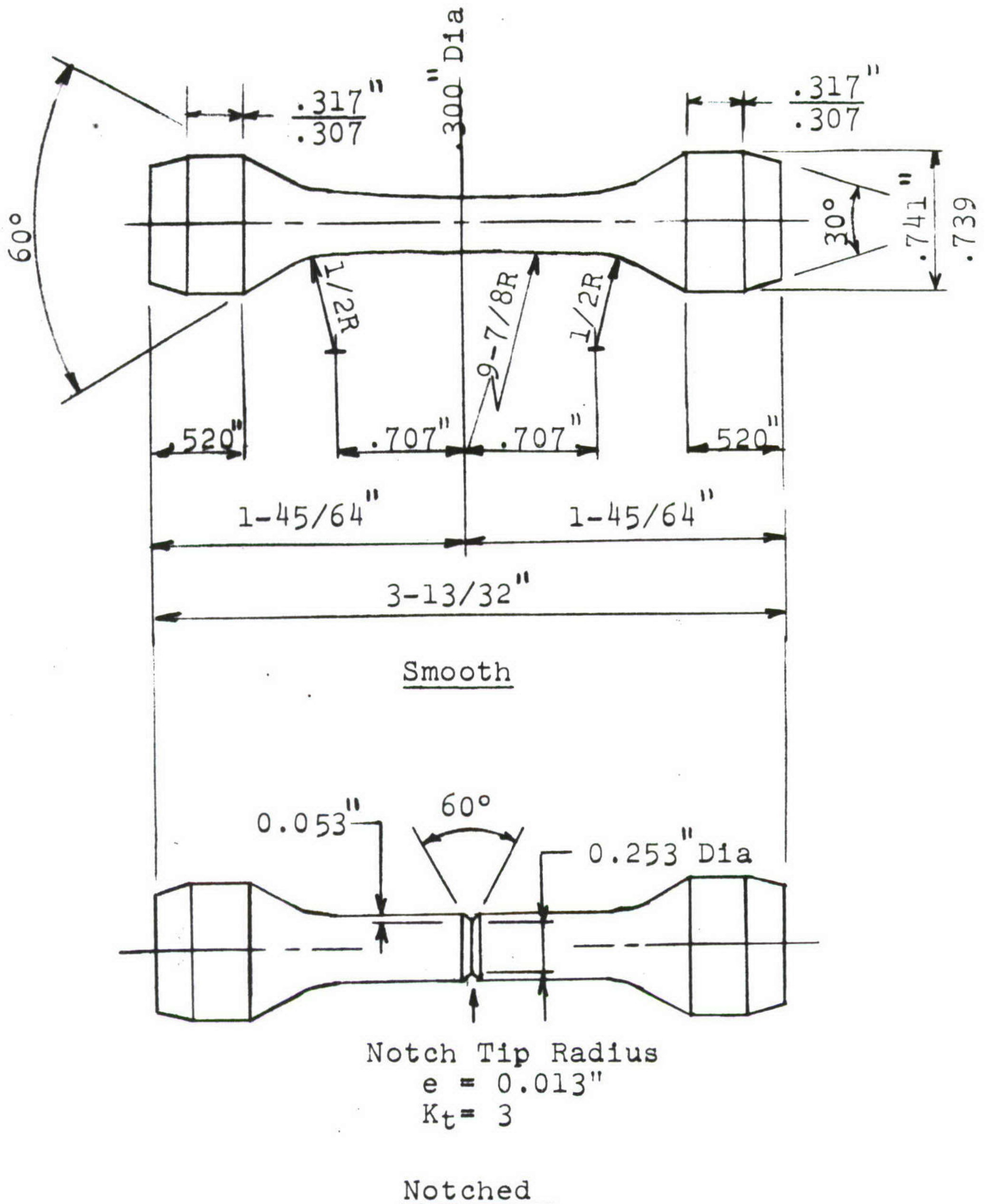


Fig. 20 Smooth and Notched Axial-Stress Fatigue Specimens

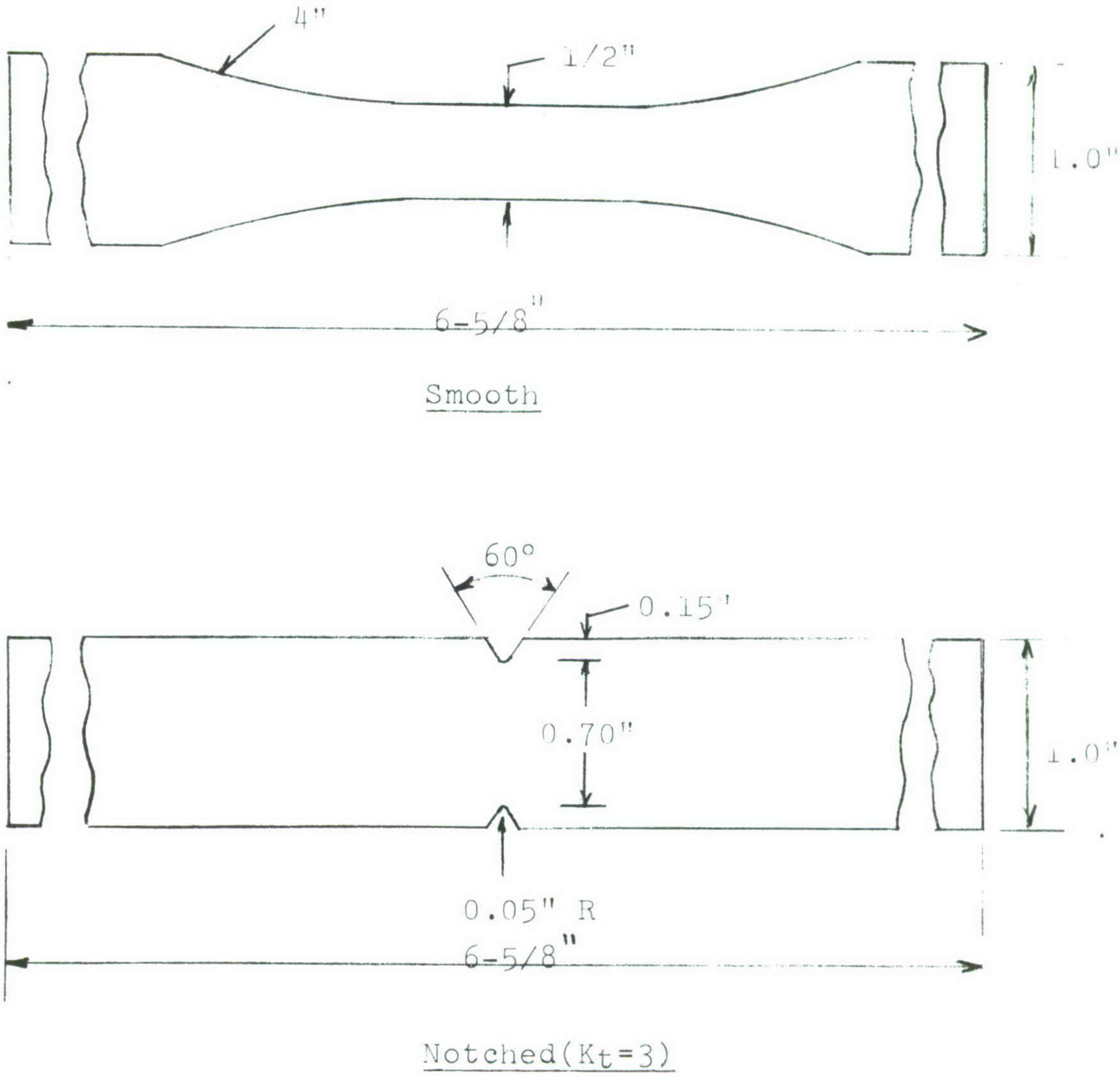


Fig. 21 Smooth and Notched Sheet-Type Axial-Stress Fatigue Specimens.

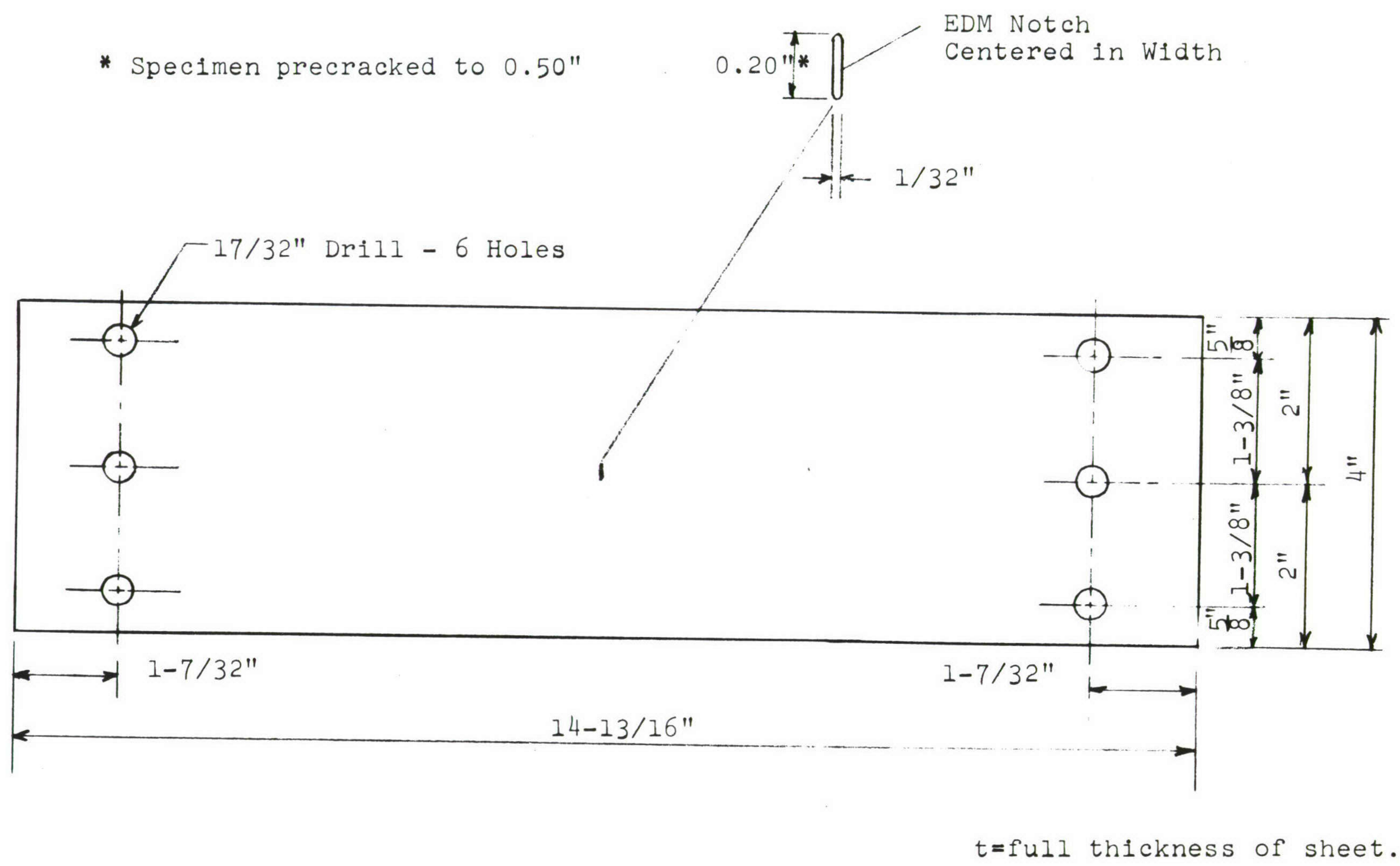
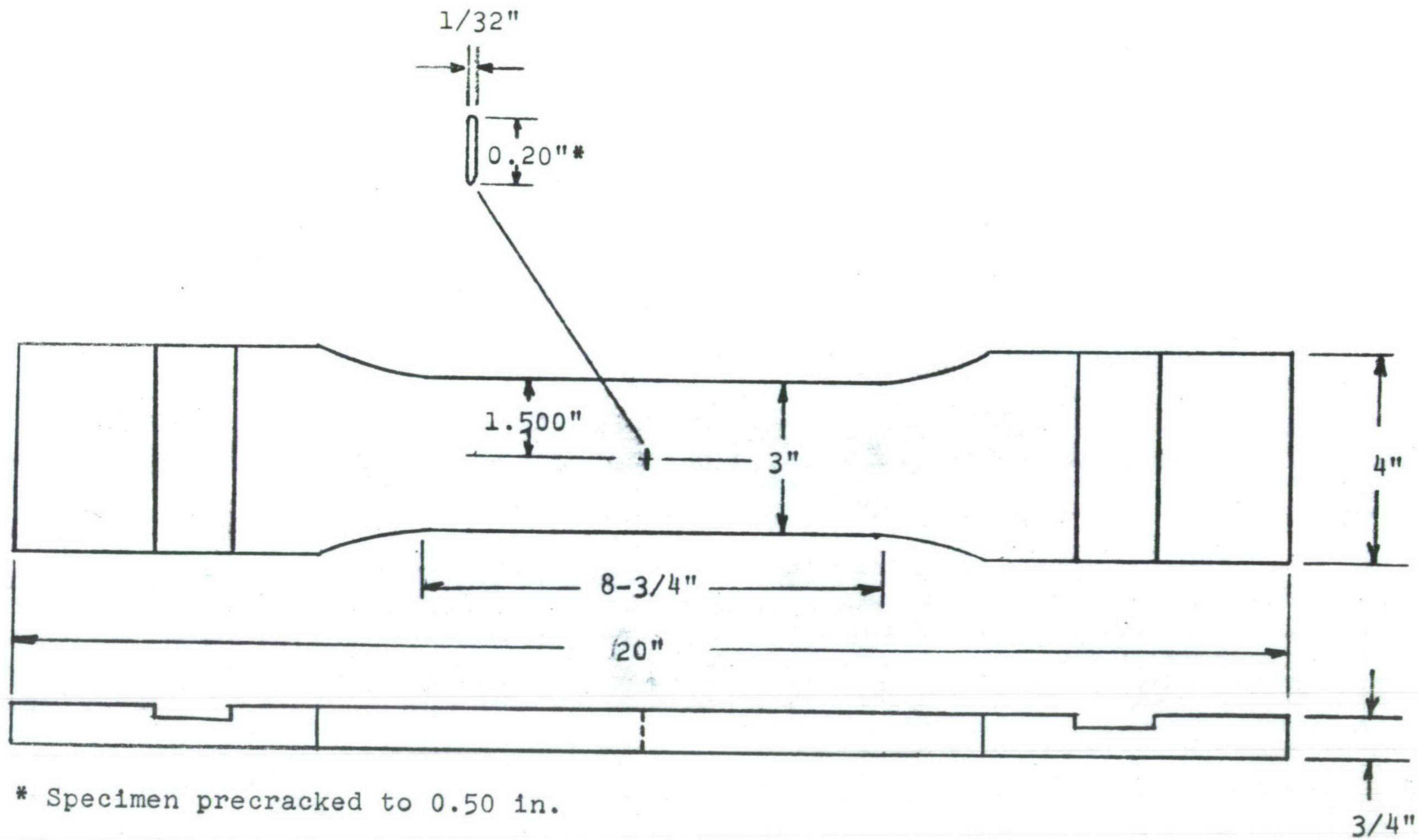
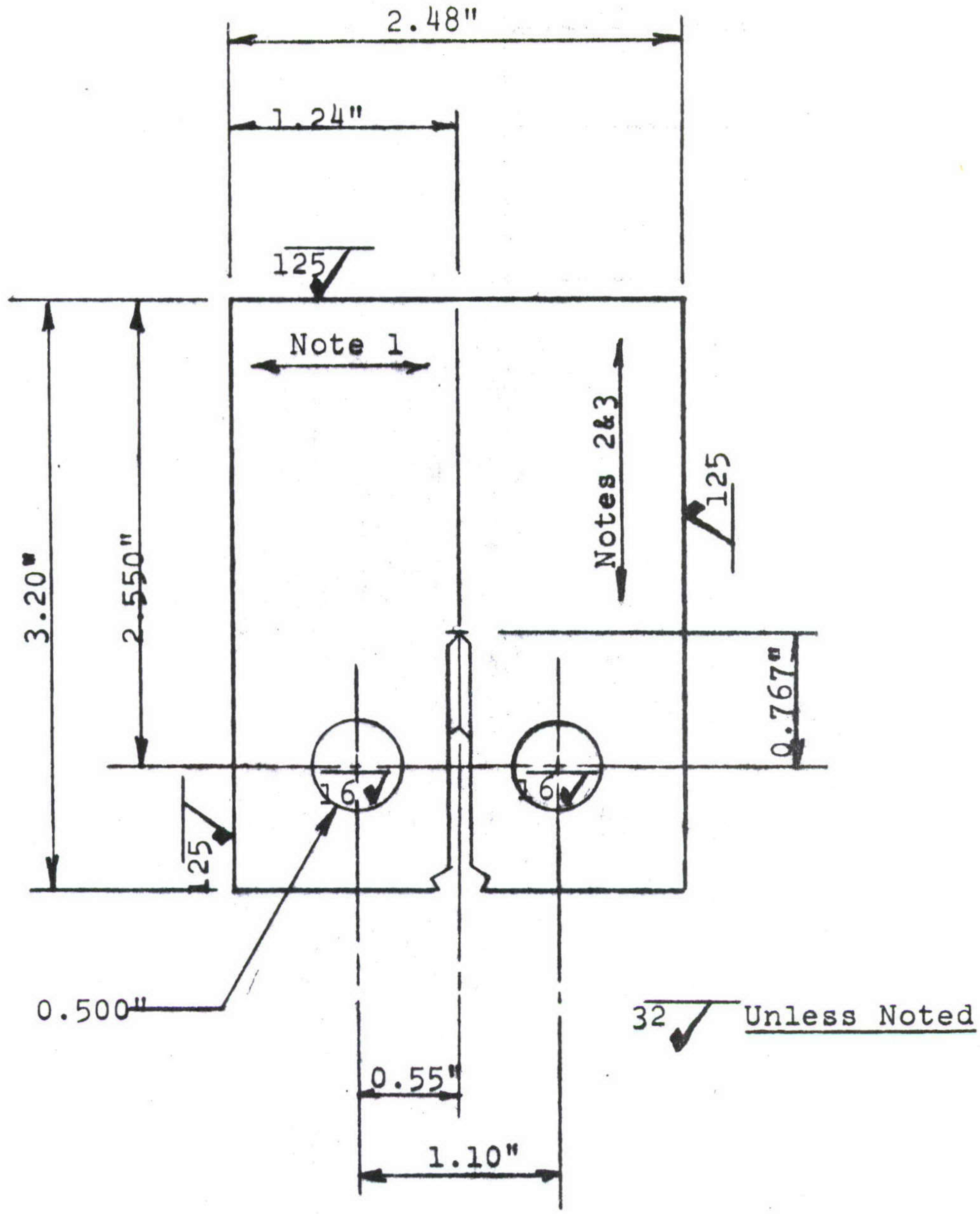


Fig. 22 Crack Propagation Specimen for Sheet



* Specimen precracked to 0.50 in.

Fig. 23 EDM Notched Crack Propagation Specimen



B, Thickness =1.00"

Note 1 - Grain in this Direction for Longitudinal Specimens.
Note 2 - Grain in this Direction for Transverse Specimens.
Note 3 - Machining Lay in this Direction for all Types of Specimens.

Fig. 24 Compact Tension Crack Growth Specimen

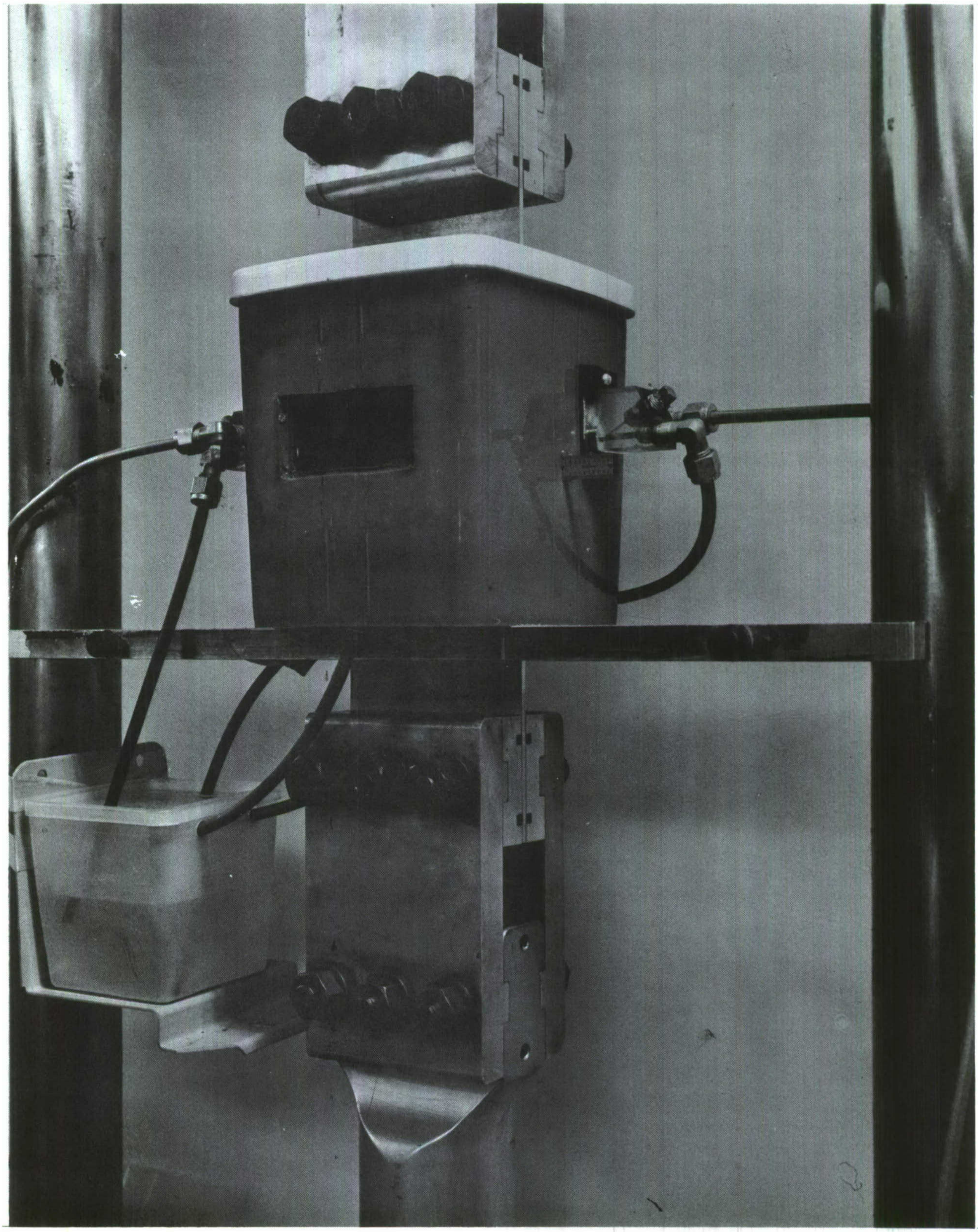


Fig. 25 Environmental Chamber for Fatigue Crack Propagation Tests of Sheet.

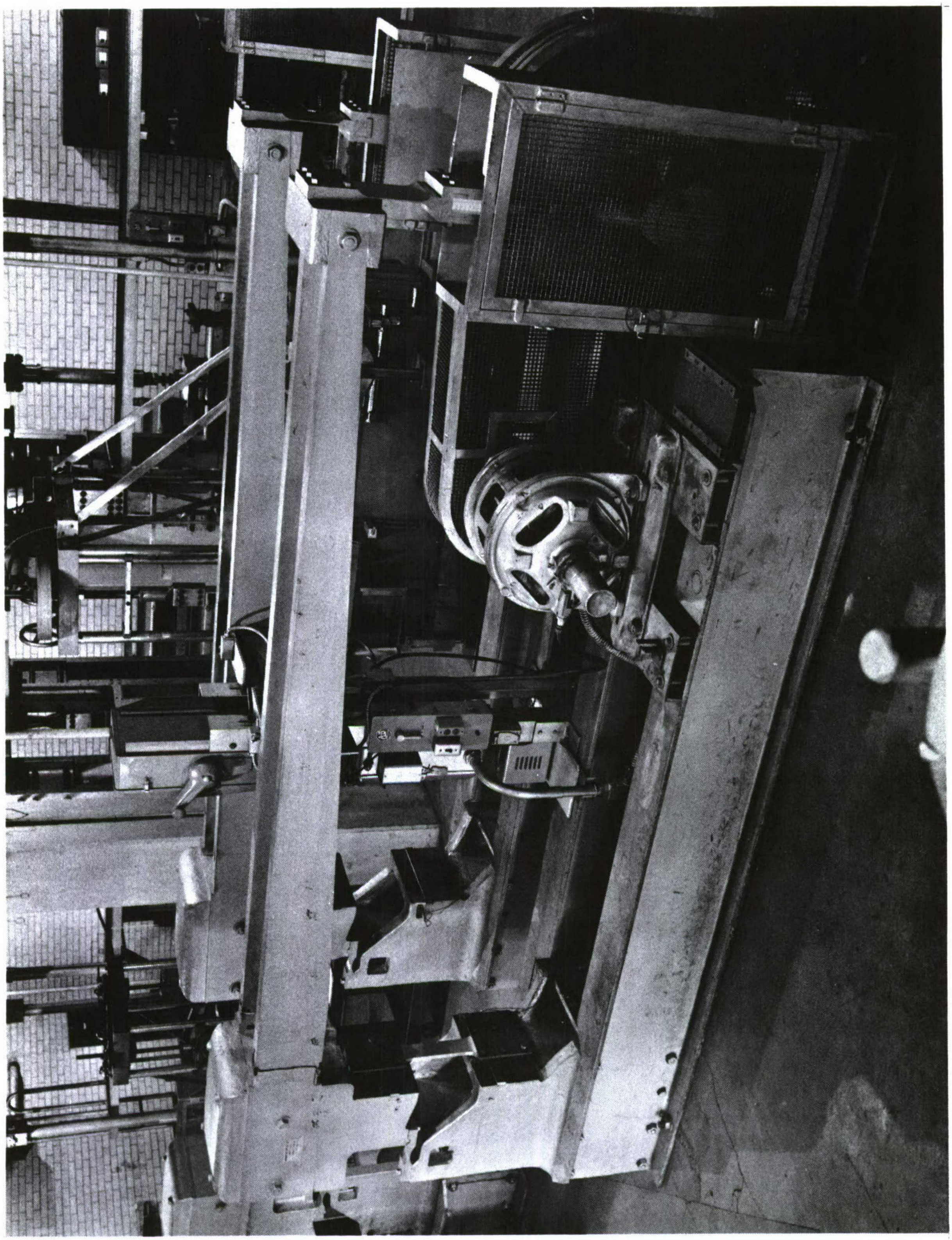


Fig. 26 ARL 50,000 lb Structural Fatigue Machine

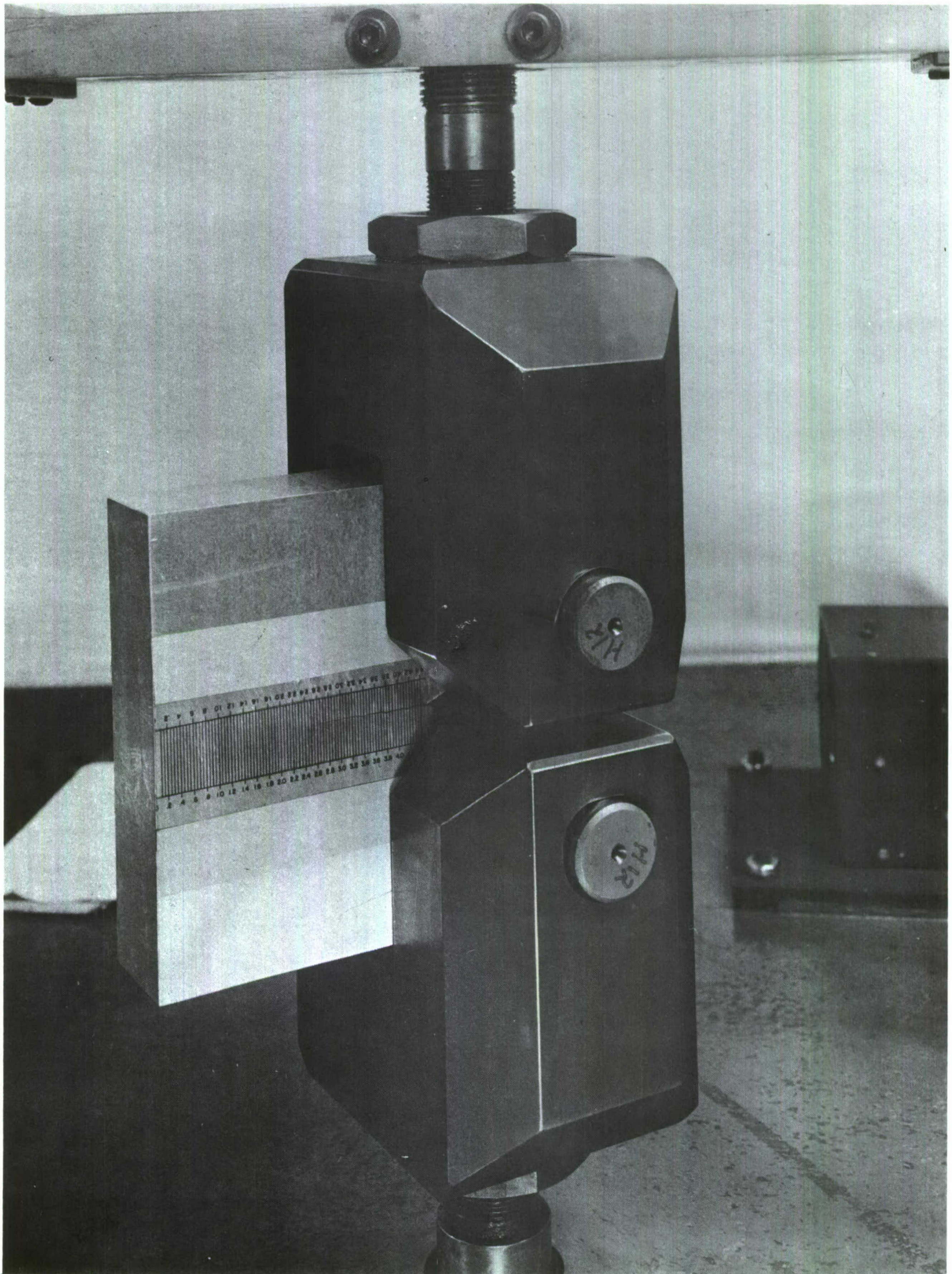


Fig. 27   Compact Tension Crack Propagation Specimen in Fatigue Machine

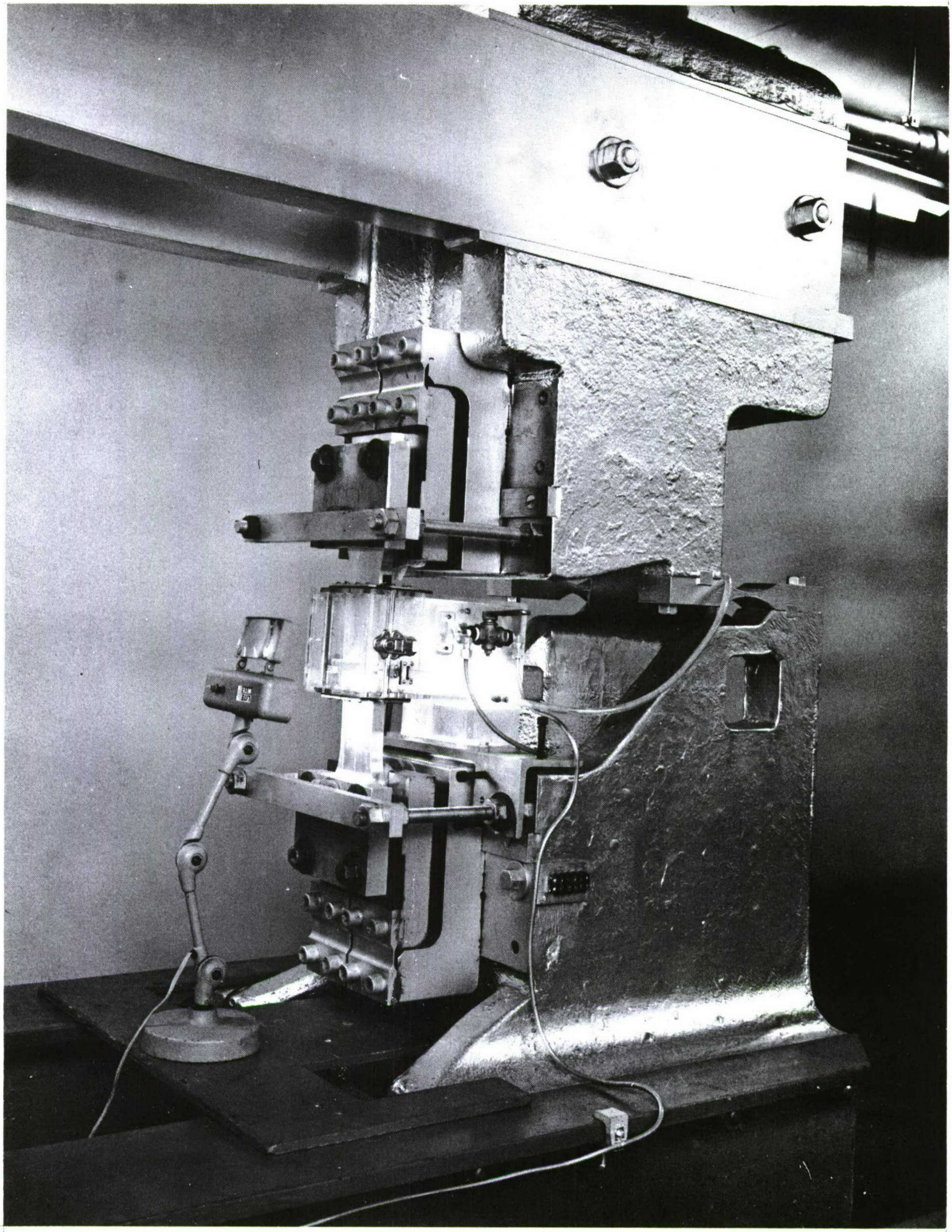


Fig. 28 Setup for Tests to Measure Environmental Fatigue-Crack-Growth Rate

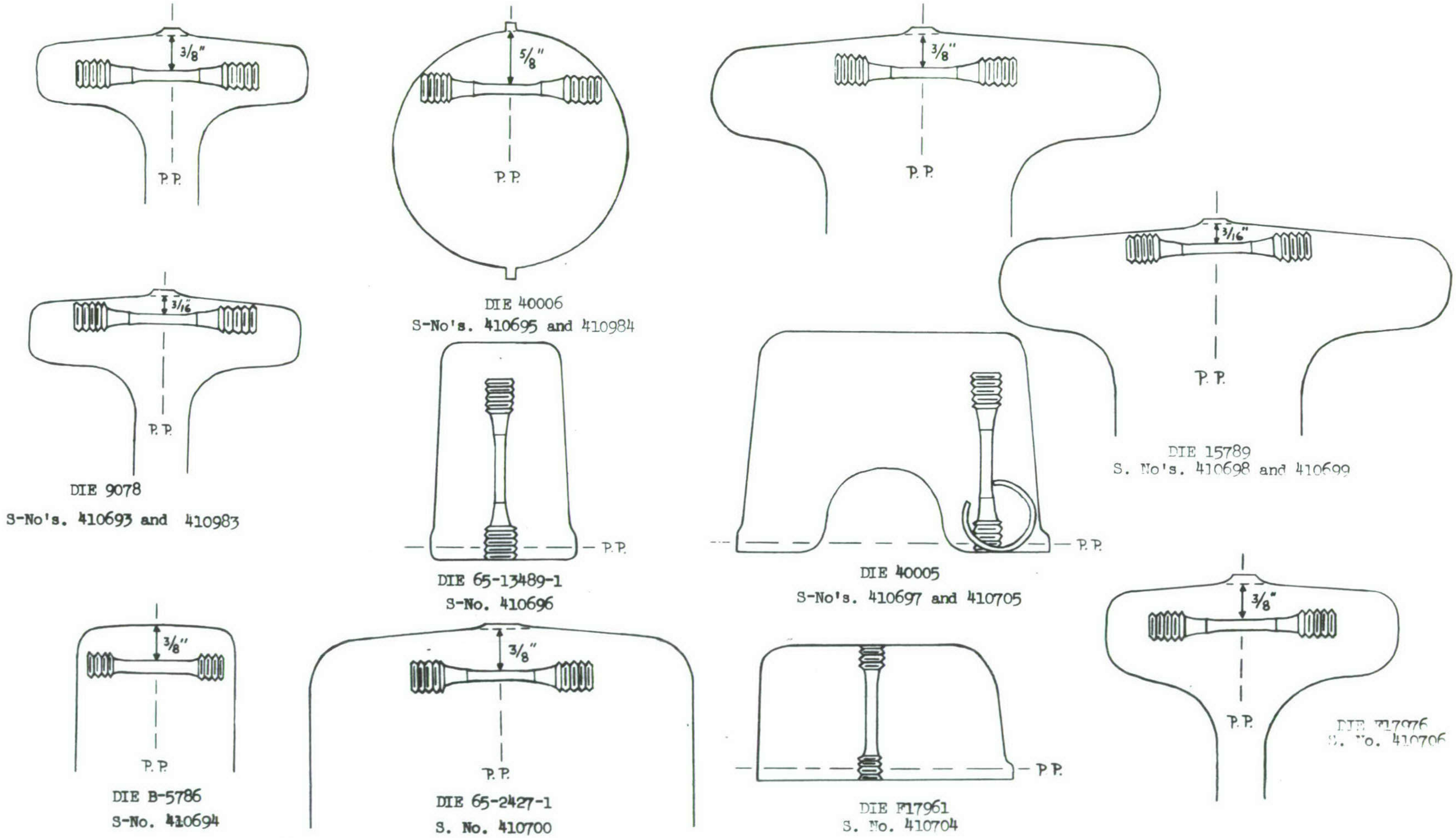


Fig. 29 Sketch Showing Location of SCC Smooth Specimens on the Cross-Section of the Die Forgings.

Fig. 29

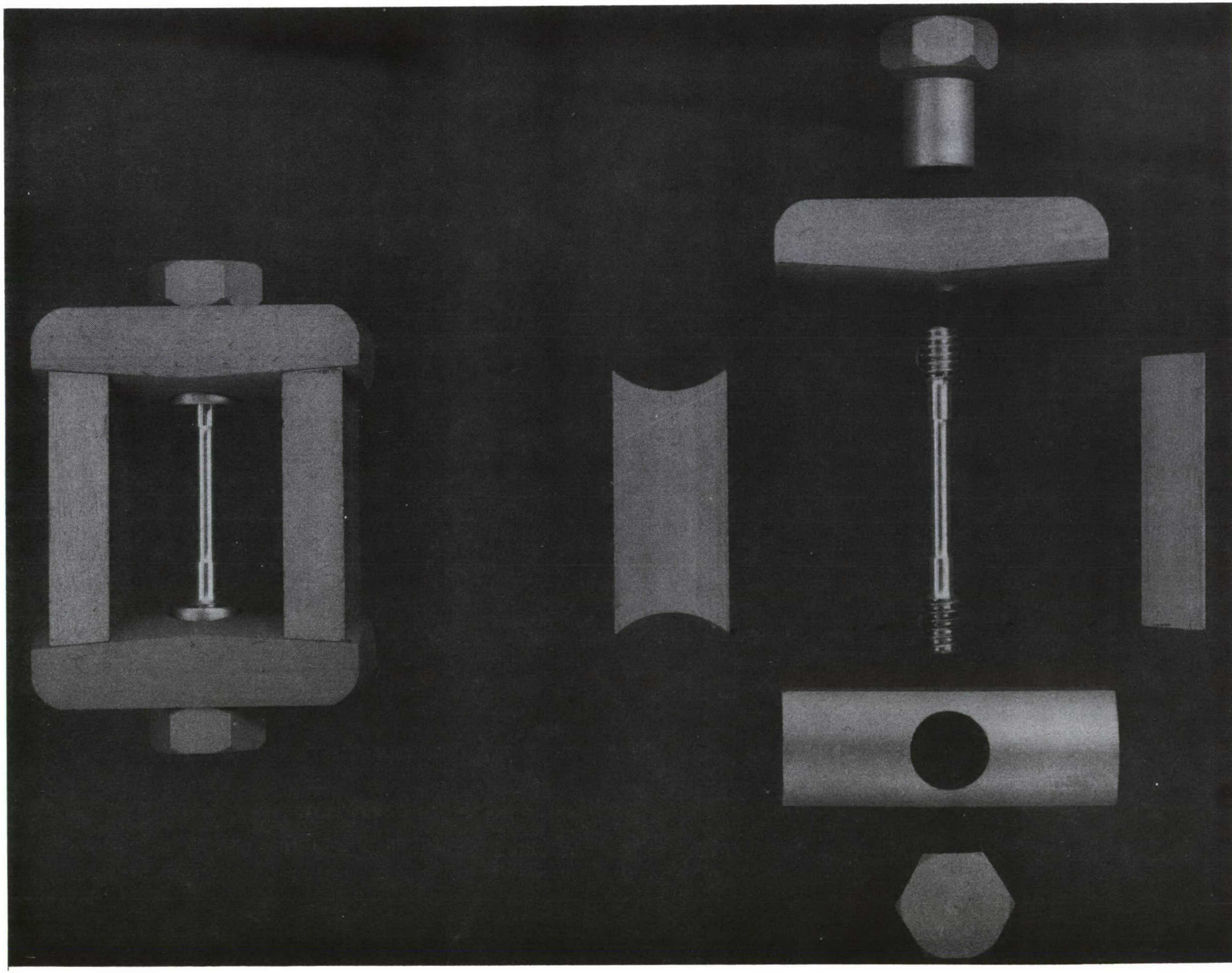


Fig. 30 Shows the 1/8-in. Diameter Tensile Specimen, the Various Parts of the Stressing Frame and the Final Stressed Assembly

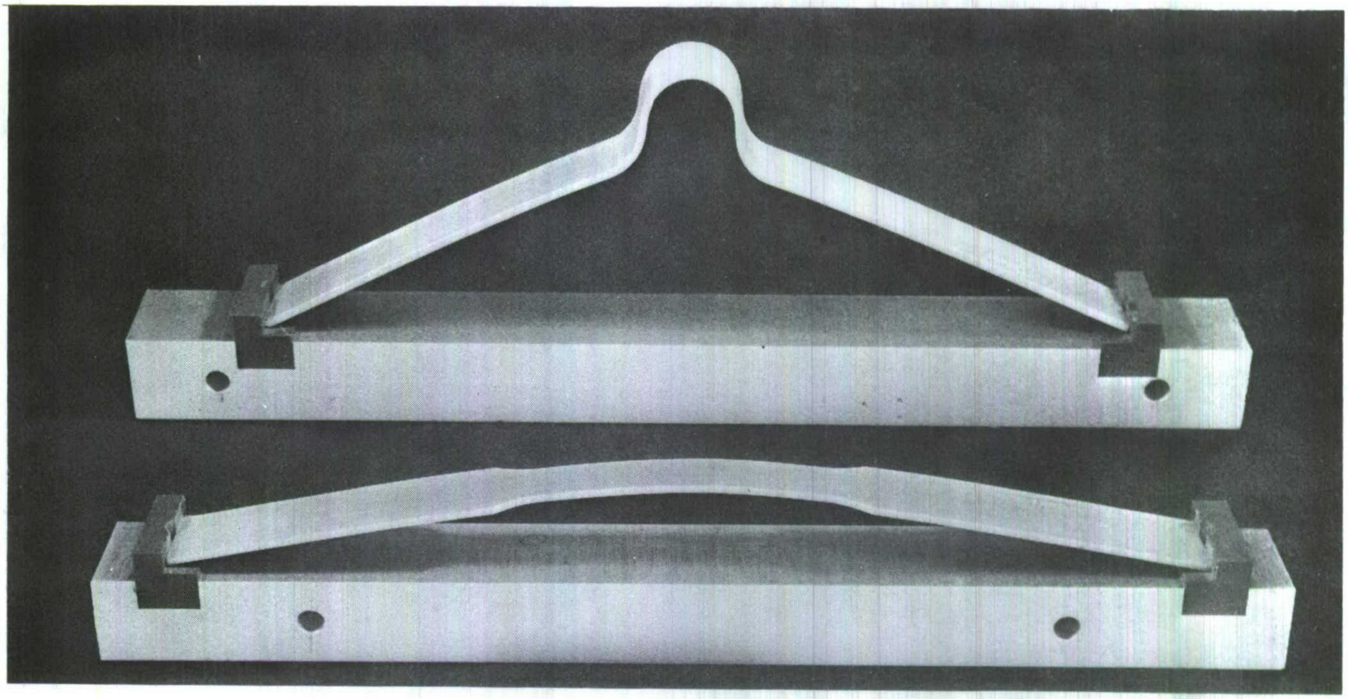


Fig. 31 Sheet-Type Tensile Specimens and Preformed
Blanks in Stress Corrosion Frames

DOUBLE CANTILEVER BEAM-(DCB SPECIMEN)

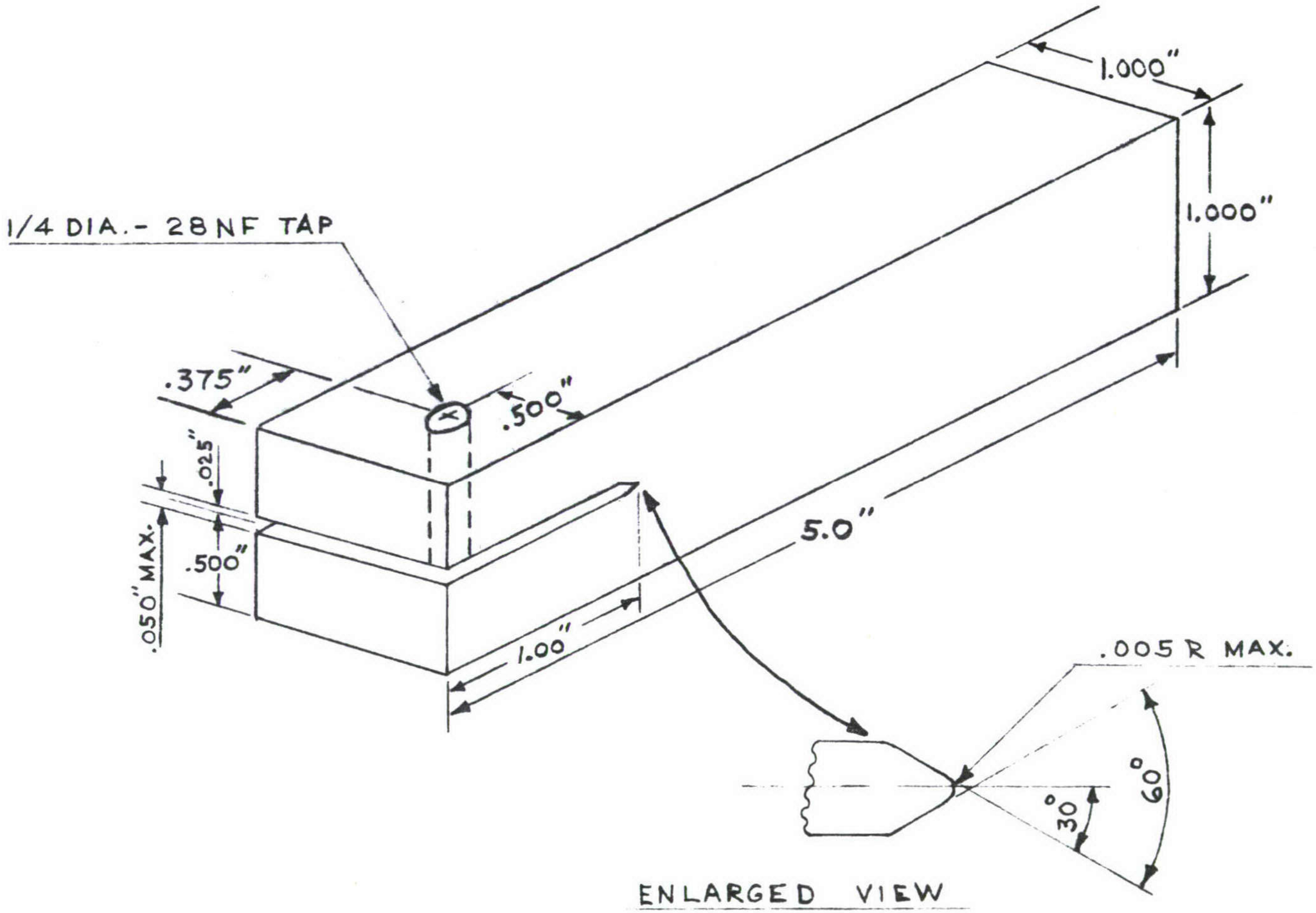
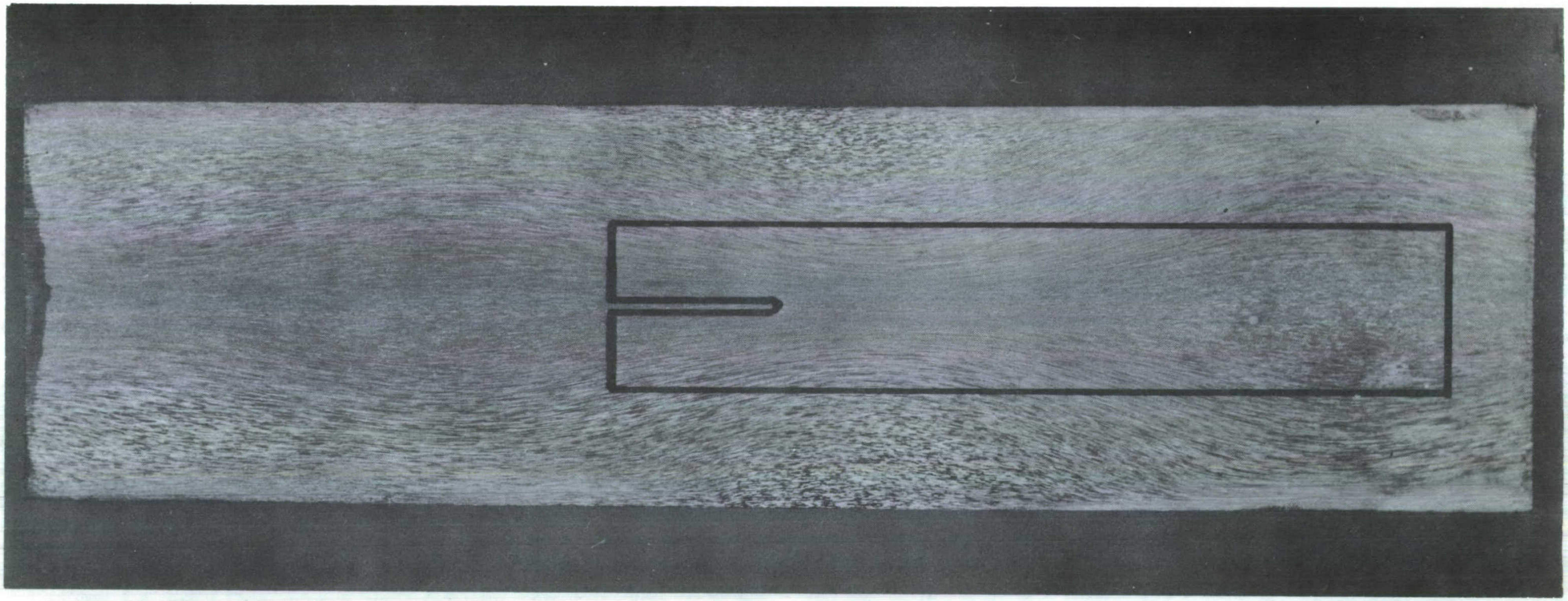


Fig. 32 Configuration of DCB specimen used for plate and hand forgings in Contract No. F-33615-71-C-1571. Specimens from die forgings were the same except height (dimension perpendicular to slot) was 9/16 in.



Approx. 1X

Fig. 33 Longitudinal Slice From the 2-in. 7049-T73 Hand Forging Macroetched to Show Grain Flow. An Undulating Grain Flow is Common in Hand Forgings, therefore Etched Slices were Obtained so that DCB Specimens could be Positioned with the Tip of the Precrack in Line with the Region of Maximum Grain Flow. Same Procedure was used for the 2-in. Forging of 7175-T736 and the 5-in. Forgings of both Alloys.

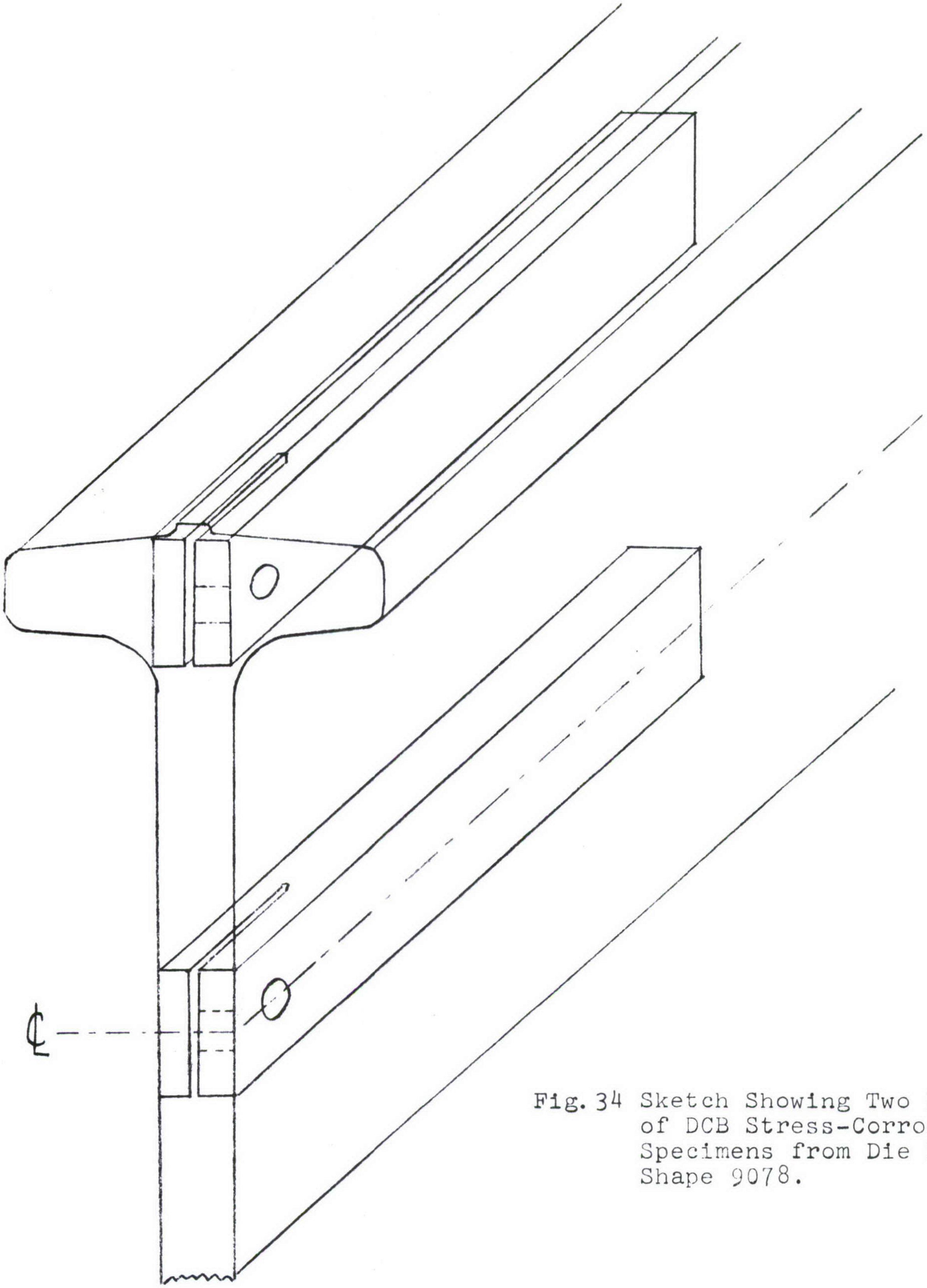


Fig. 34 Sketch Showing Two Locations of DCB Stress-Corrosion Specimens from Die Forged Shape 9078.

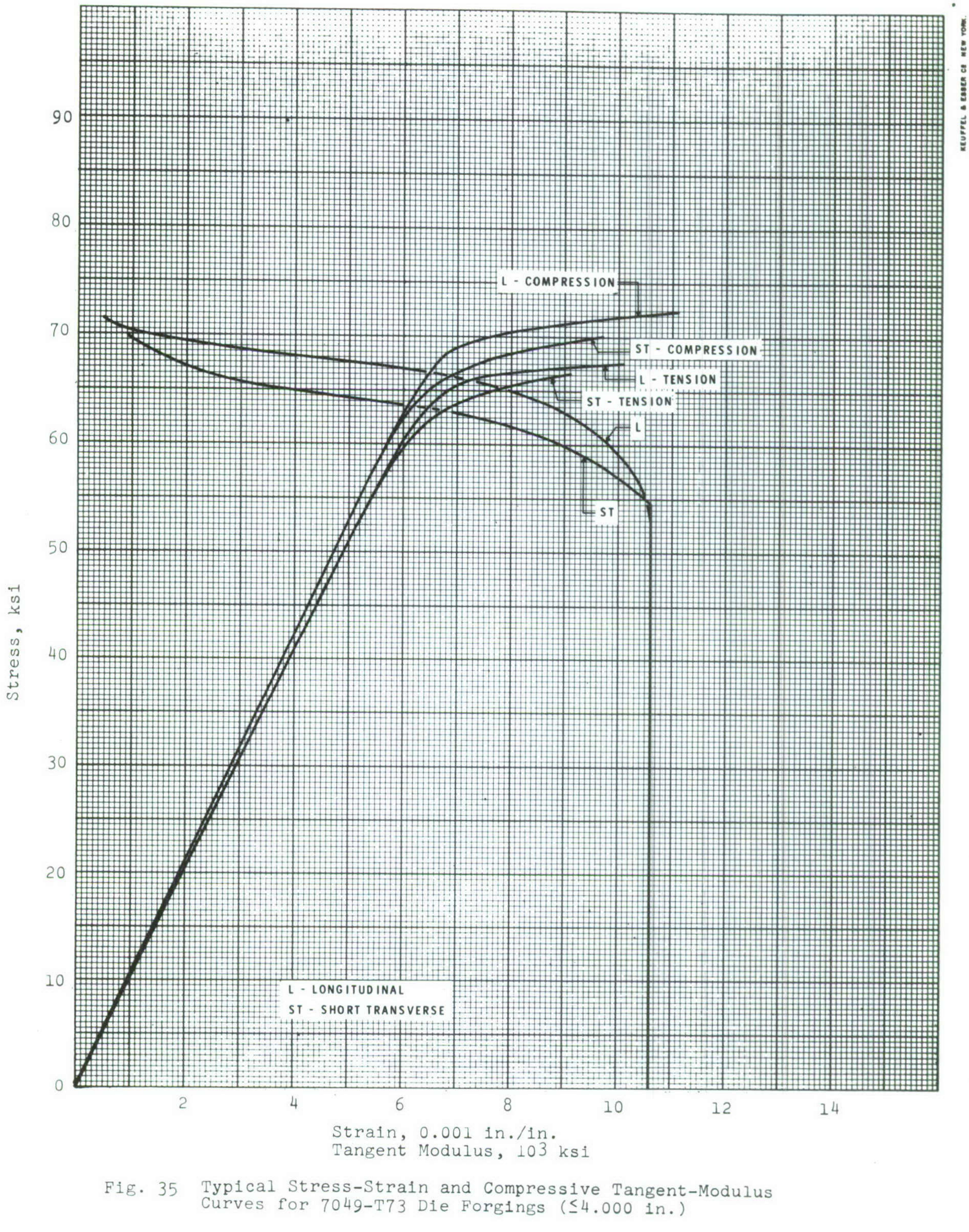


Fig. 35 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7049-T73 Die Forgings (≤4.000 in.)

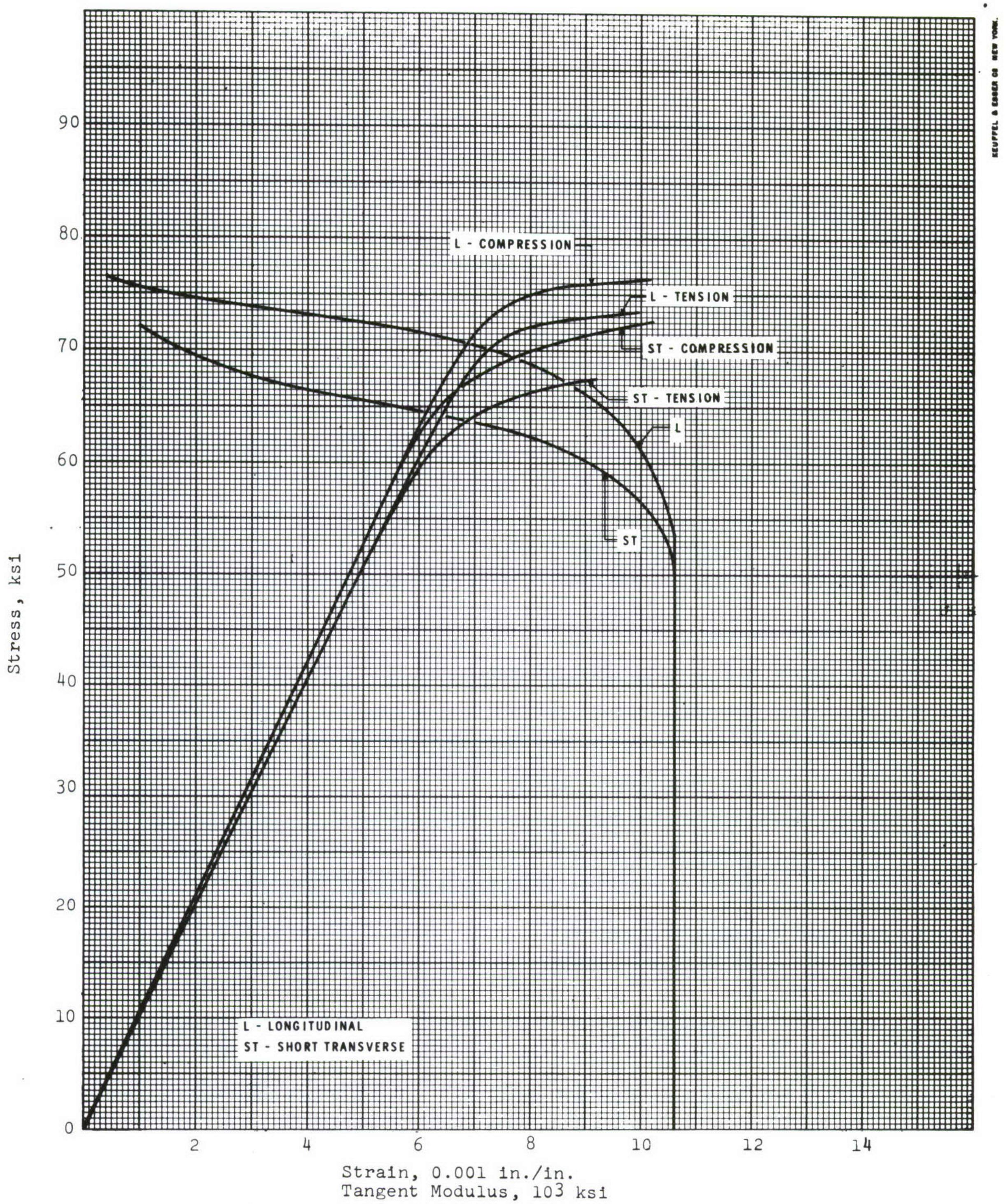


Fig. 36 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7175-T736 Die Forgings (≤3.000 in.)

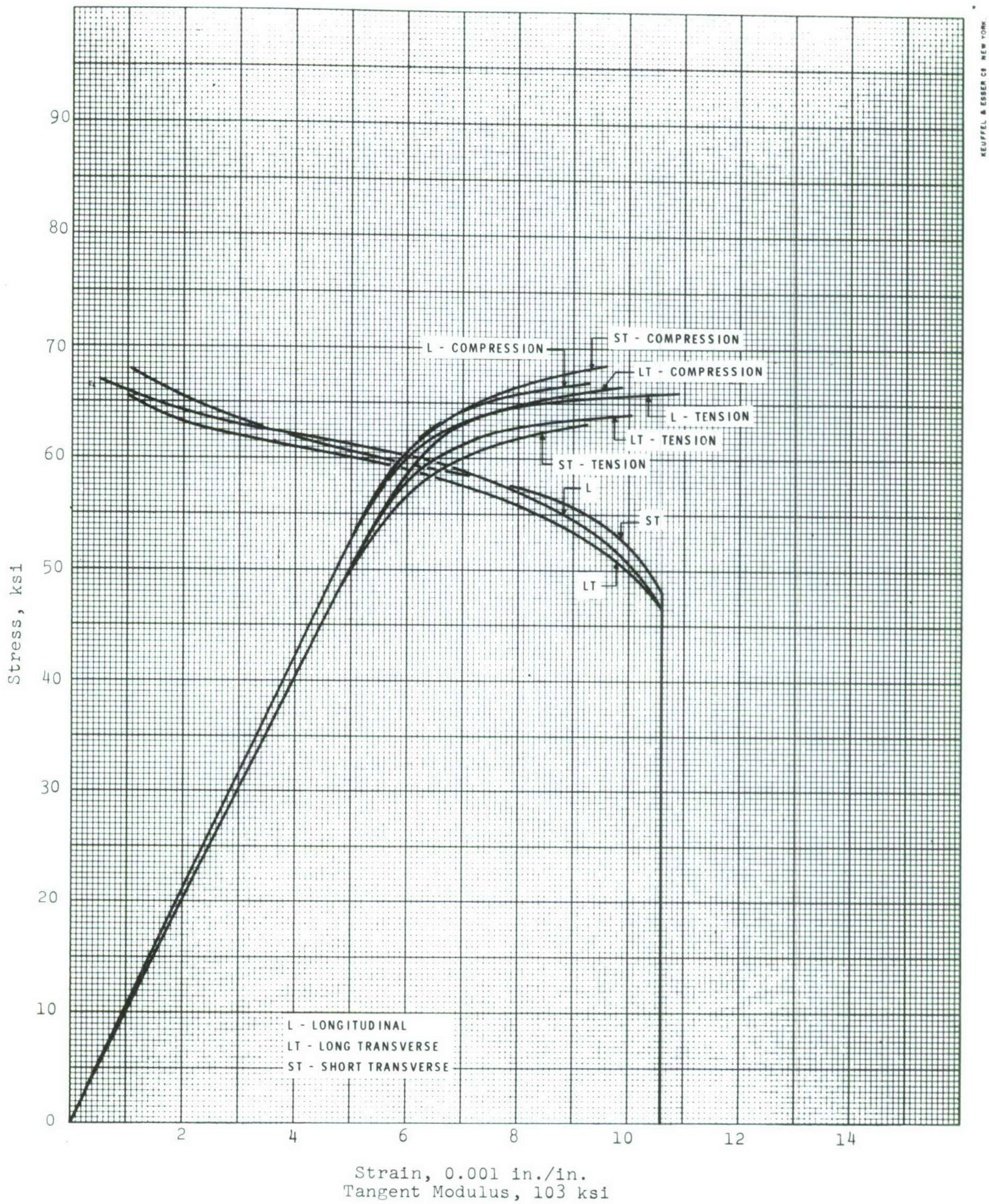


Fig. 37 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7049-T73 Hand Forgings (2.001-5.000 in.)

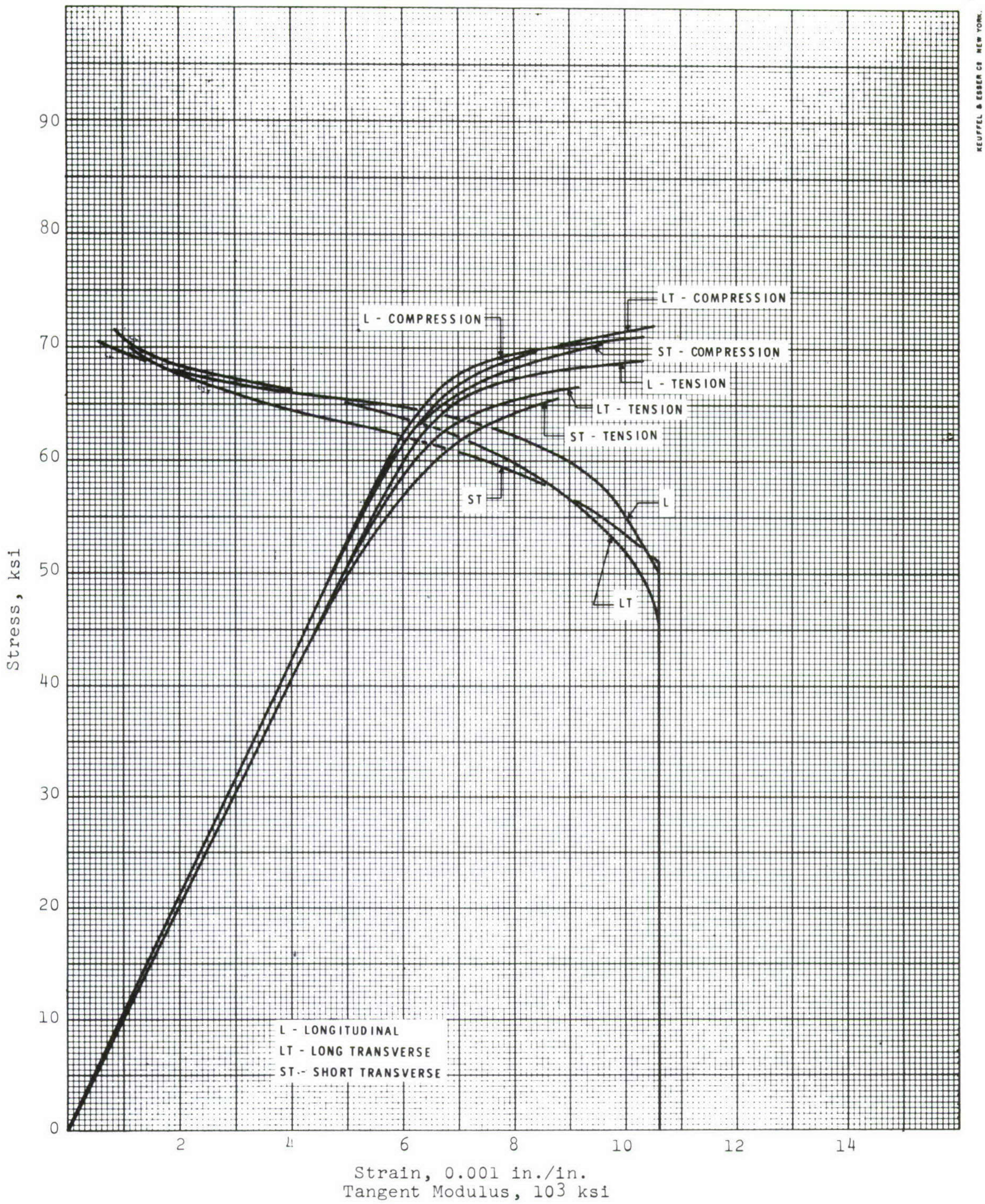


Fig. 38 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7175-T736 Hand Forgings (≤4.000 in.)

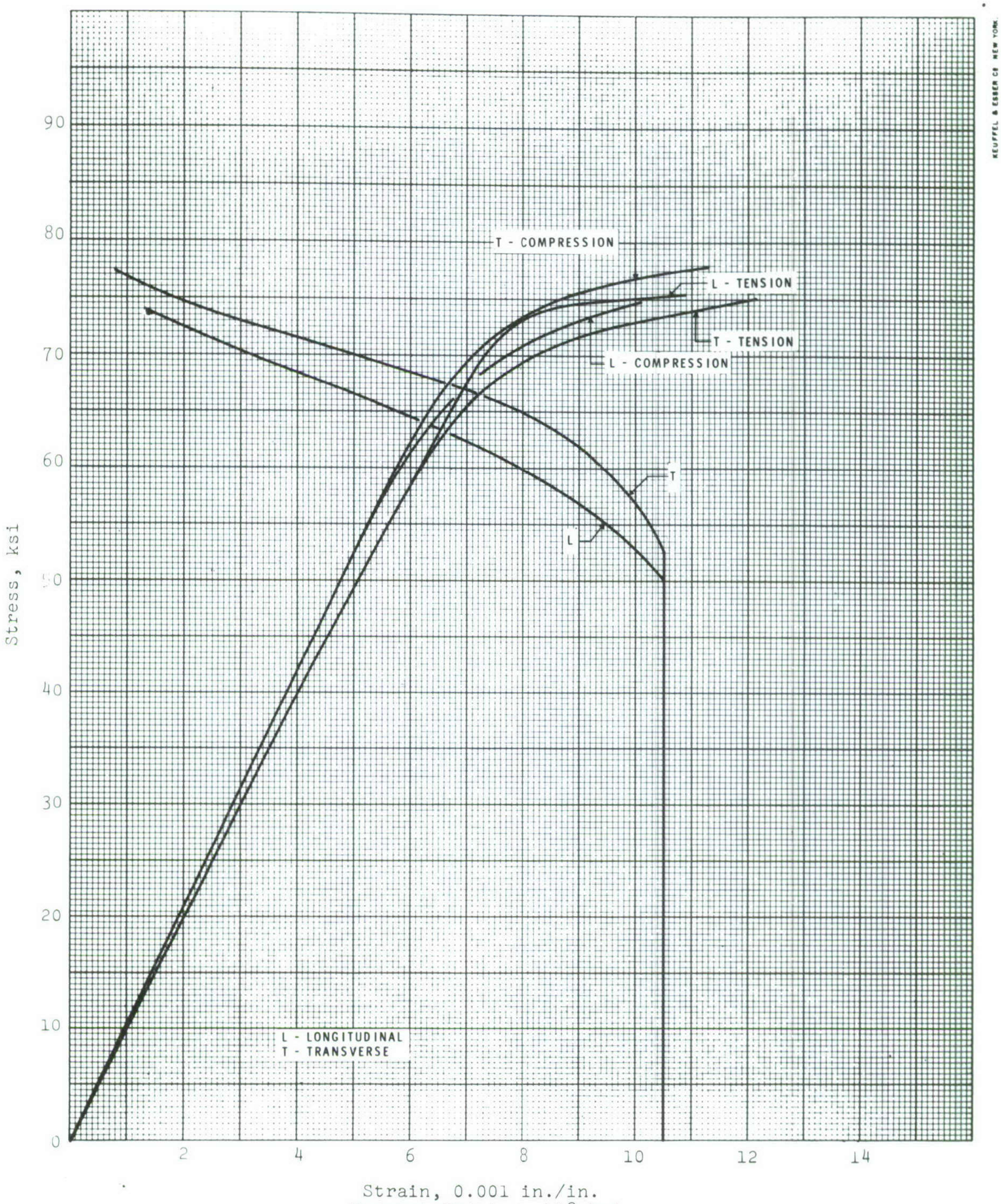


Fig. 39 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7475-T61 Sheet (0.040-0.249 in.)

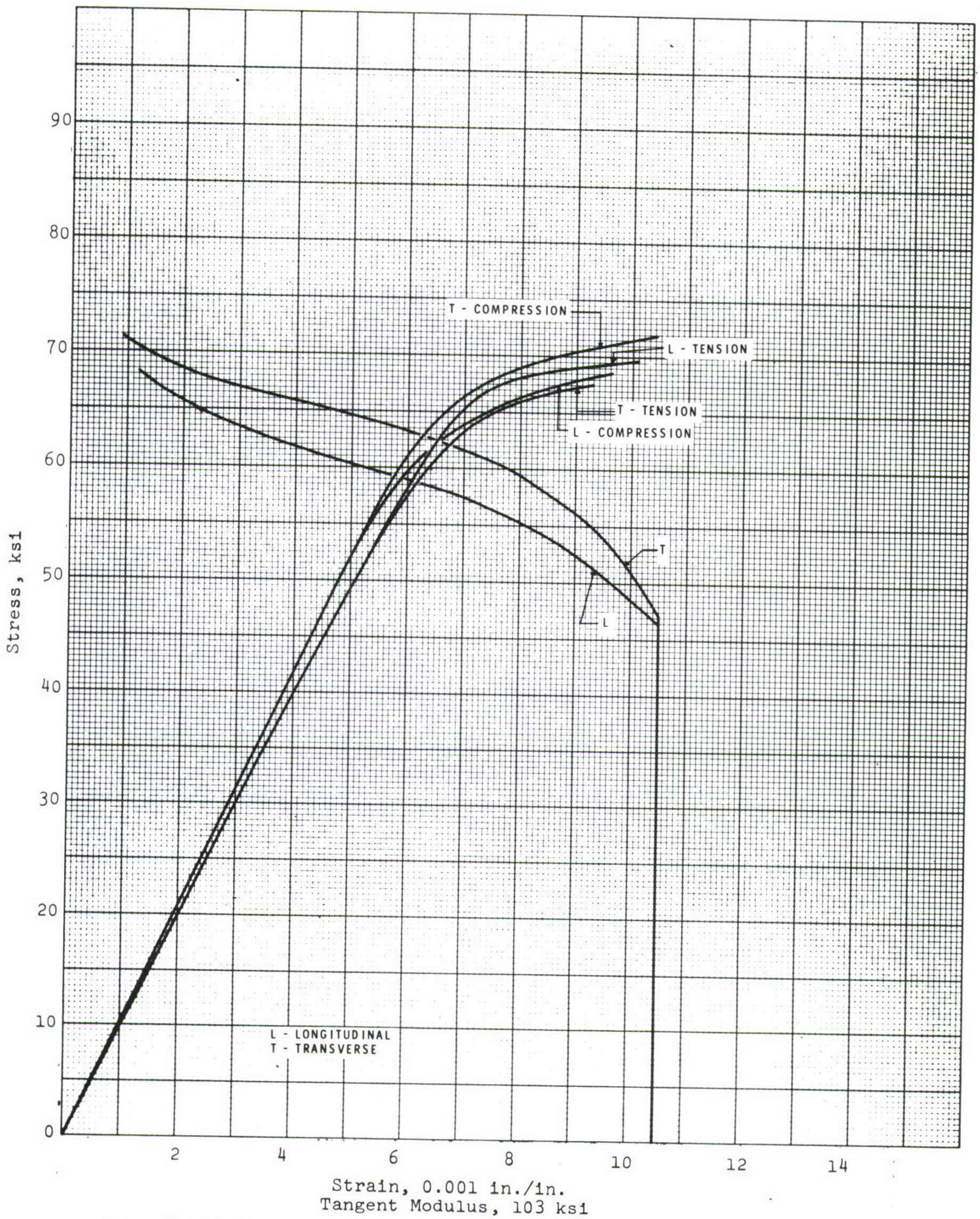


Fig. 40 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 7475-T761 Sheet (0.040-0.249 in.)

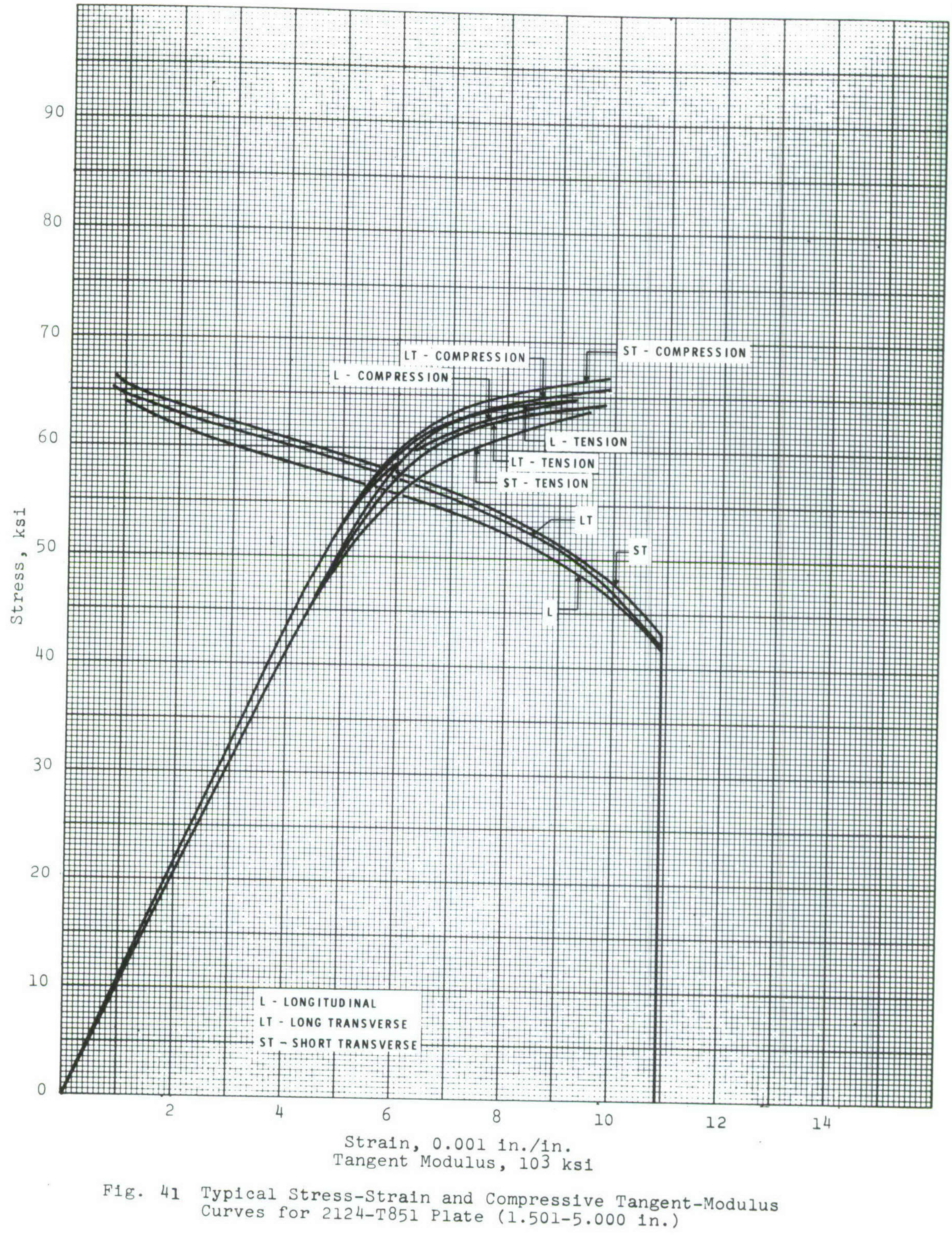
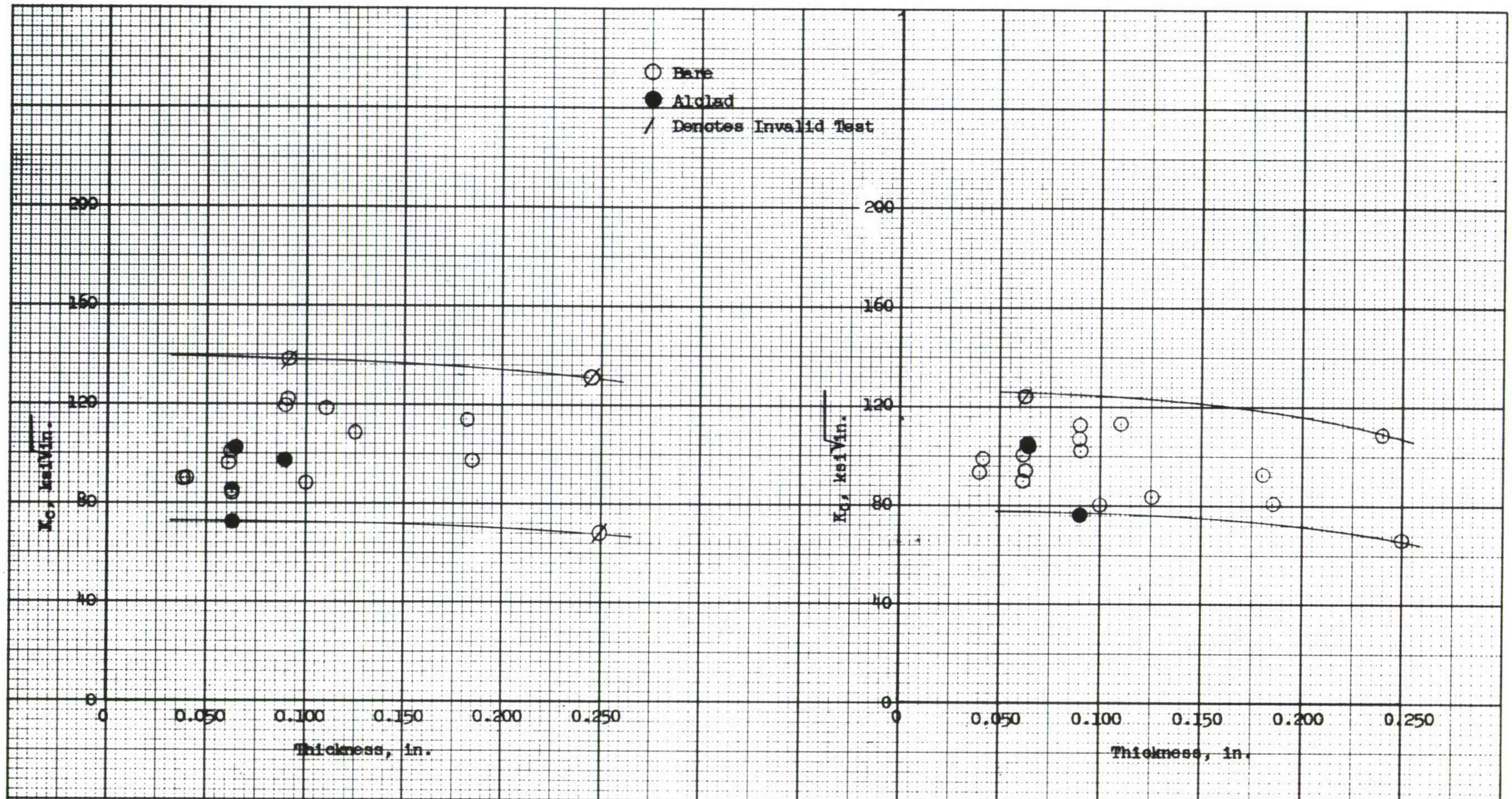


Fig. 41 Typical Stress-Strain and Compressive Tangent-Modulus Curves for 2124-T851 Plate (1.501-5.000 in.)



ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA

Plane-Stress Fracture Toughness of Bare and Alclad 7475-T61 Sheet Determined in Tests of 16-in. Wide Panels (Compliance) (F33615-71-C-1571)

PLOTTED FJC DATE 2-21-73 APPROVED ___ DATE ___

Fig. 42

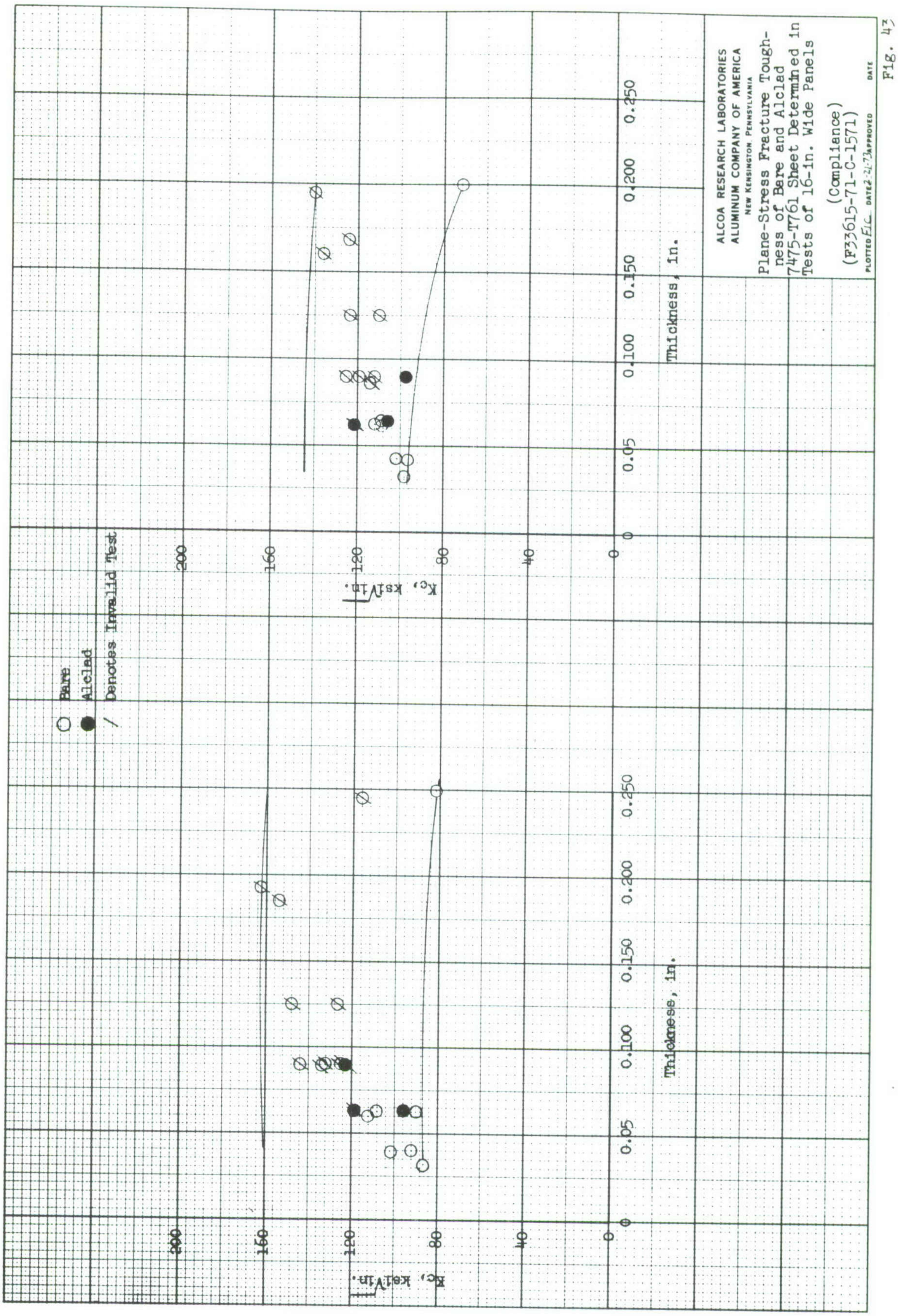
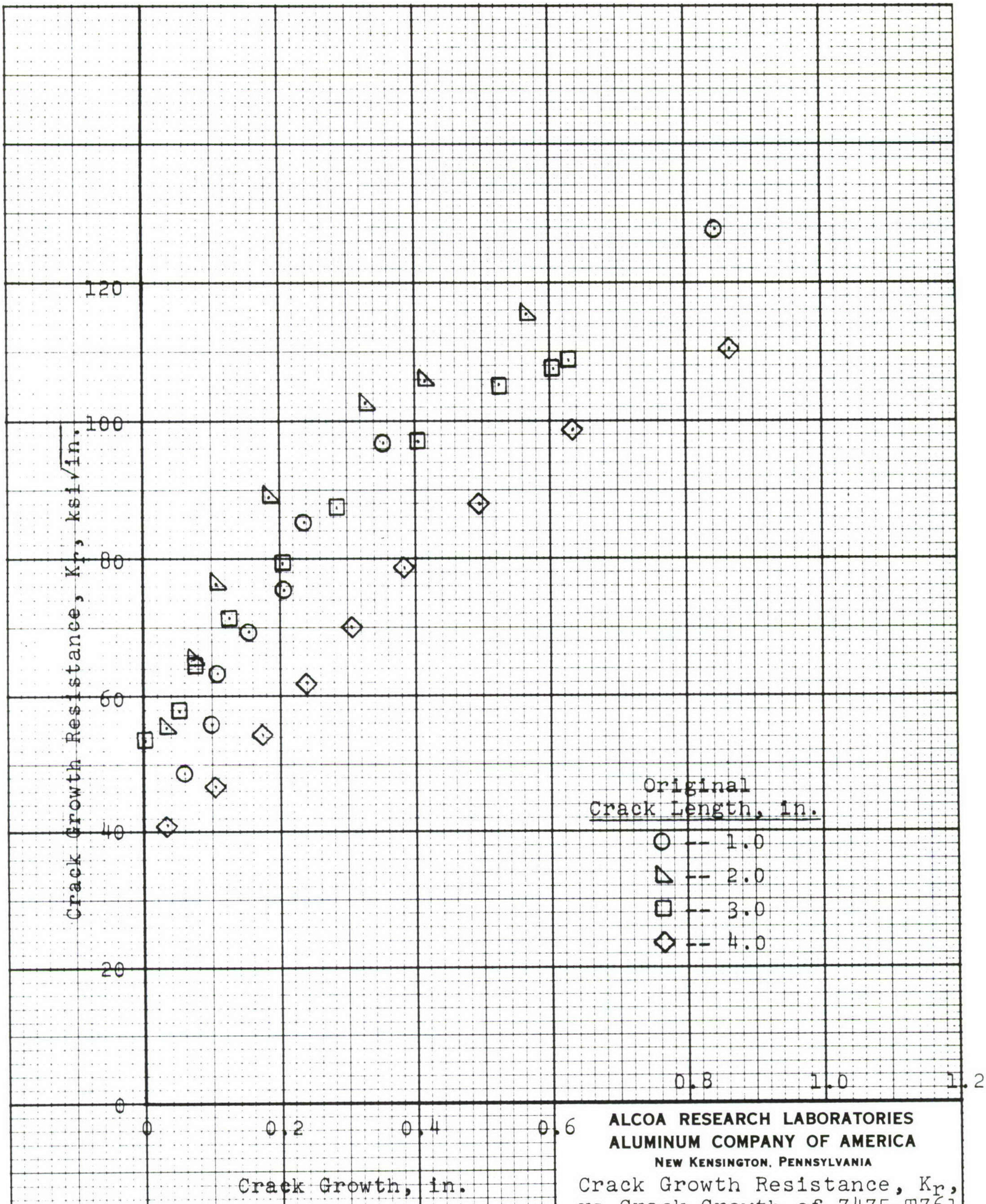

ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON PENNSYLVANIA
Plane-Stress Fracture Toughness of Bare and Alclad 7475-T761 Sheet Determined in Tests of 16-in. Wide Panels
(Compliance)
(F33615-71-C-1571)
PLOTTED F.I.C. DATE 2-21-73 APPROVED DATE
Fig. 43
Bare
Alclad
/ Denotes Invalid Test
K_c, ksi$\sqrt{in.}$
Thickness, in.
0
40
80
120
160
200
0.05
0.100
0.150
0.200
0.250

Fig. 43



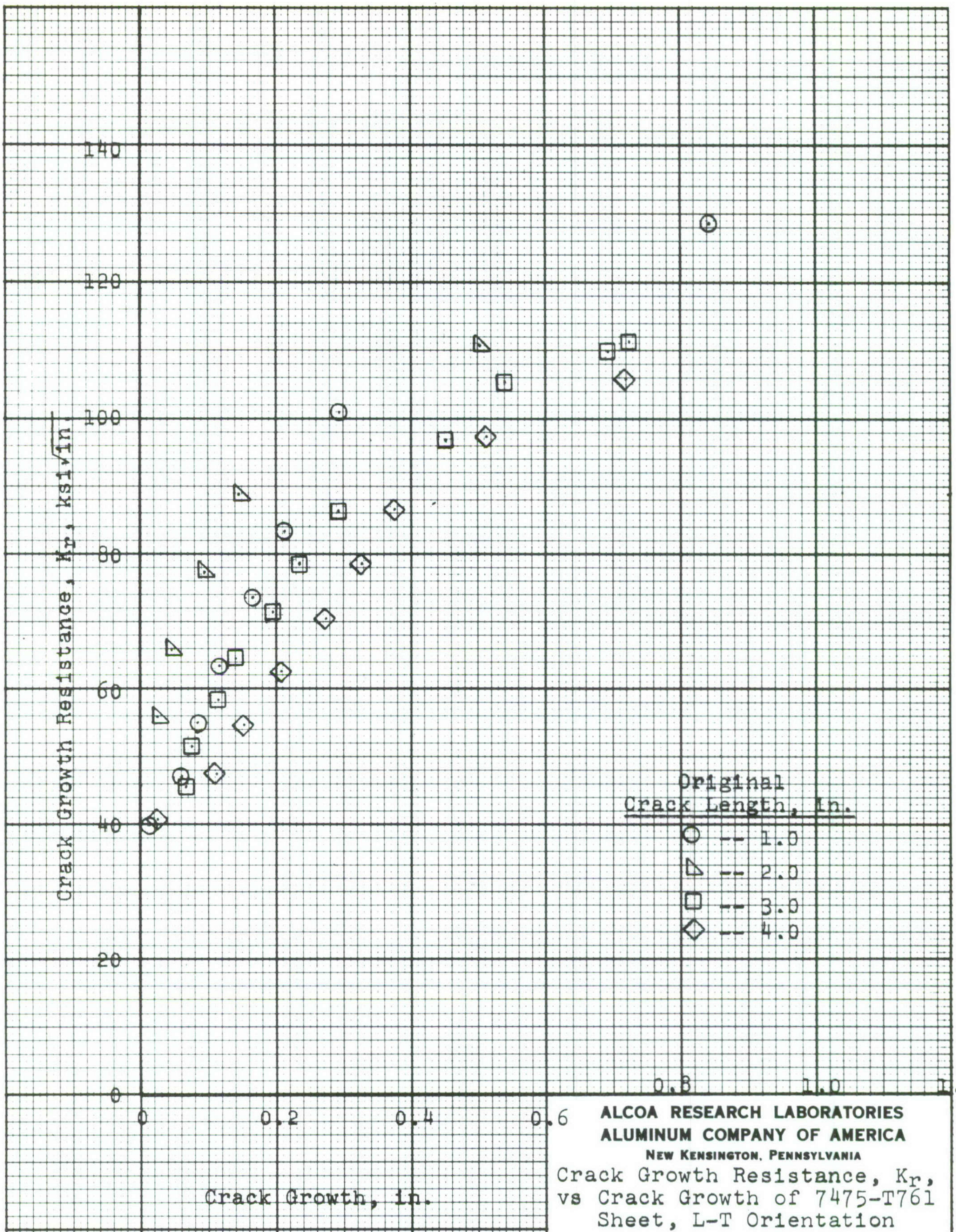
ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA

Crack Growth Resistance, K_r, vs Crack Growth of 7475-T761 Sheet, T-L Orientation

(F33615-71-C-1571)

PLOTTED RW DATE 1-17-73 APPROVED ______ DATE ______

Fig. 44



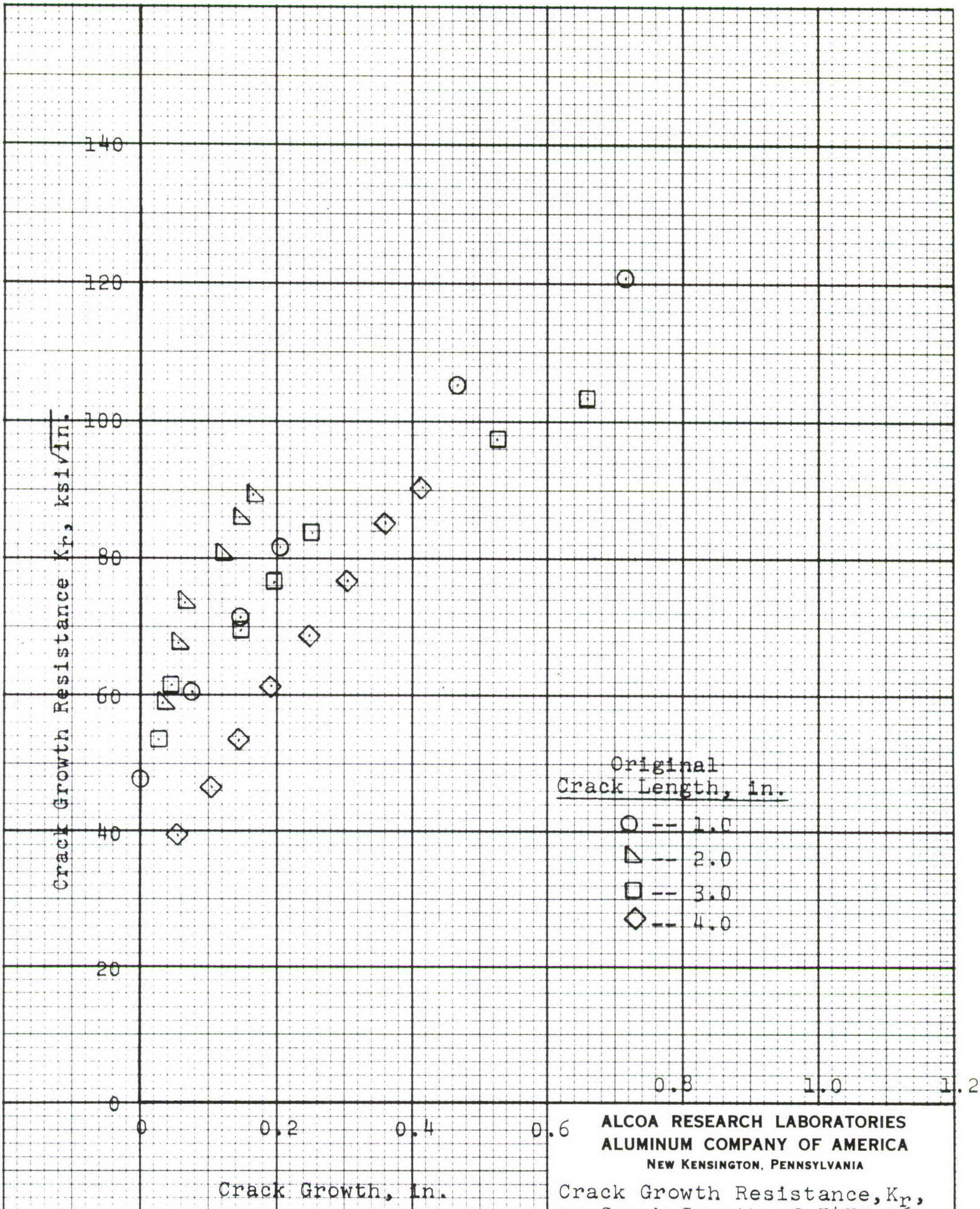
ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA

Crack Growth Resistance, K_r, vs Crack Growth of 7475-T761 Sheet, L-T Orientation

(F33615-71-C-1571)

PLOTTED RW DATE 1-17-73 APPROVED ______ DATE ______

Fig. 45



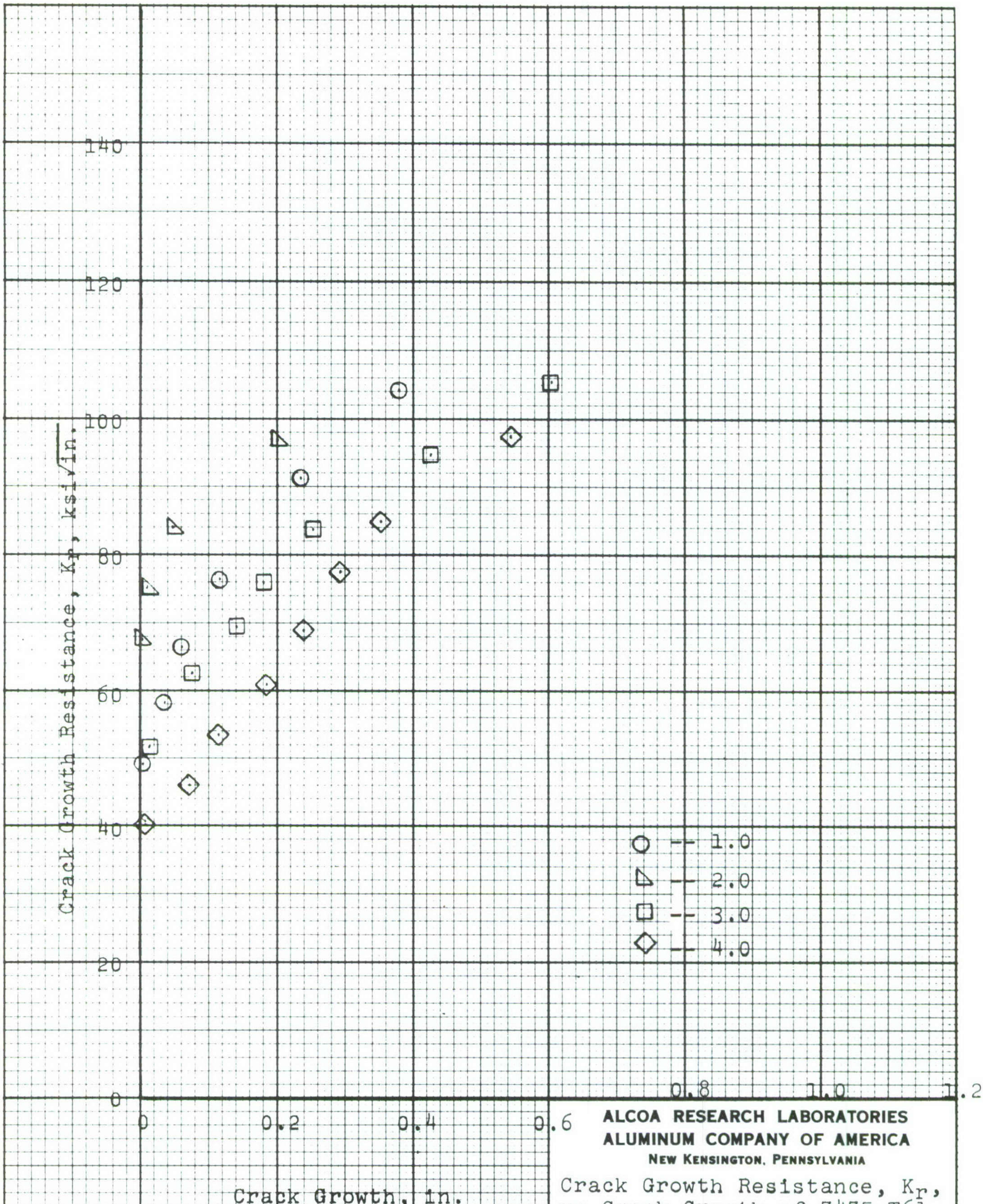
ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA

Crack Growth Resistance, K_r, vs Crack Growth of 7475-T61 Sheet, T-L Orientation

(F33615-71-C-1571)

PLOTTED RW DATE 1-17-73 APPROVED______ DATE______

Fig. 46



ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA

Crack Growth Resistance, K_r, vs Crack Growth of 7475-T61 Sheet, L-T Orientation

(F33615-71-C-1571)

PLOTTED RW DATE 1-17-73 APPROVED ______ DATE ______

Fig. 47

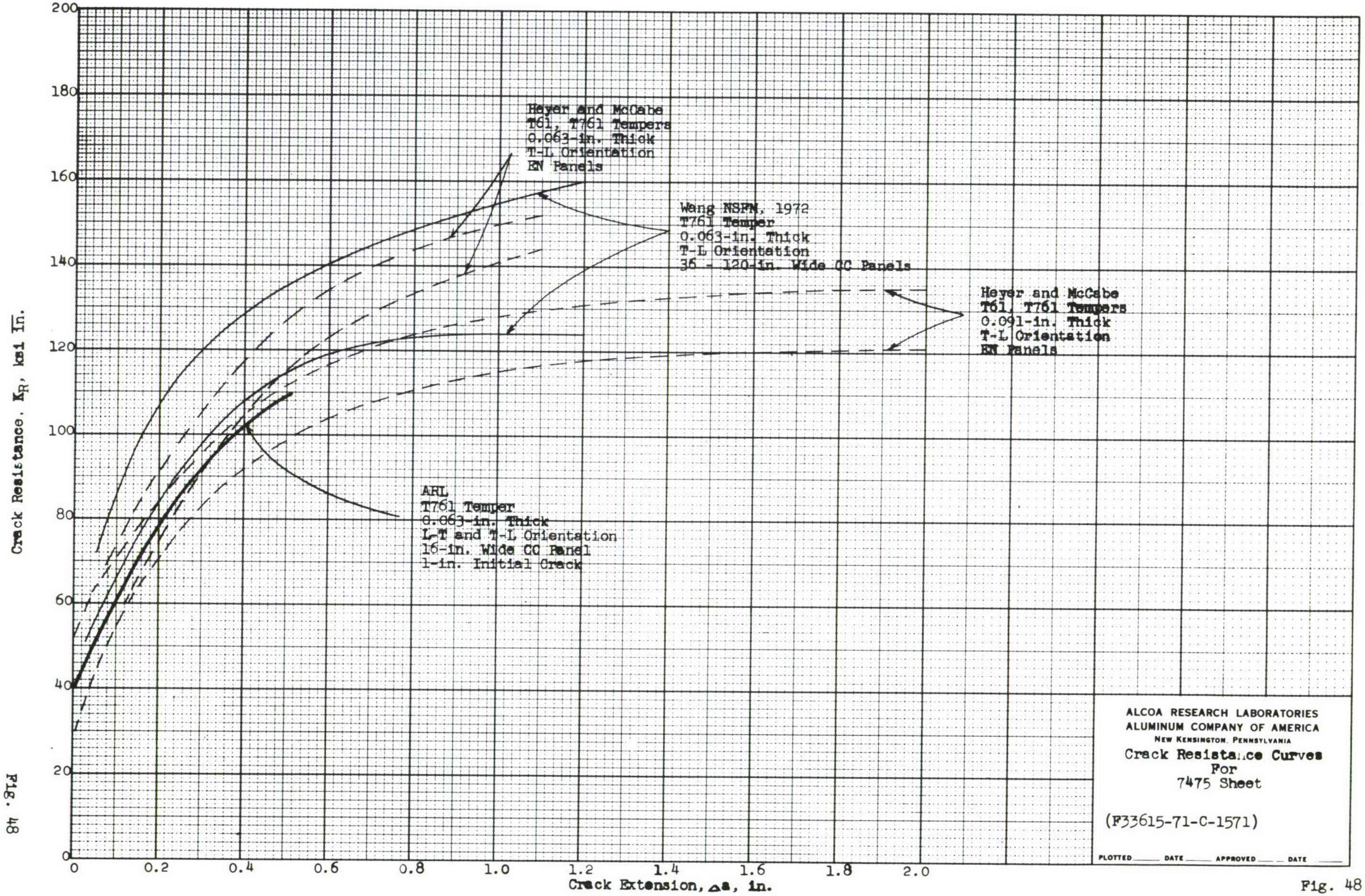

Heyer and McCabe
T61, T761 Tempers
0.063-in. Thick
T-L Orientation
EN Panels
Wang NSFN, 1972
T761 Temper
0.063-in. Thick
T-L Orientation
36 - 120-in. Wide CC Panels
Heyer and McCabe
T61, T761 Tempers
0.091-in. Thick
T-L Orientation
EN Panels
ARL
T761 Temper
0.063-in. Thick
L-T and T-L Orientation
16-in. Wide CC Panel
1-in. Initial Crack
Crack Resistance, K_R, ksi $\sqrt{in.}$
Crack Extension, Δa, in.
ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA
Crack Resistance Curves
For
7475 Sheet
(F33615-71-C-1571)
PLOTTED DATE APPROVED DATE
Fig. 48

Fig. 48

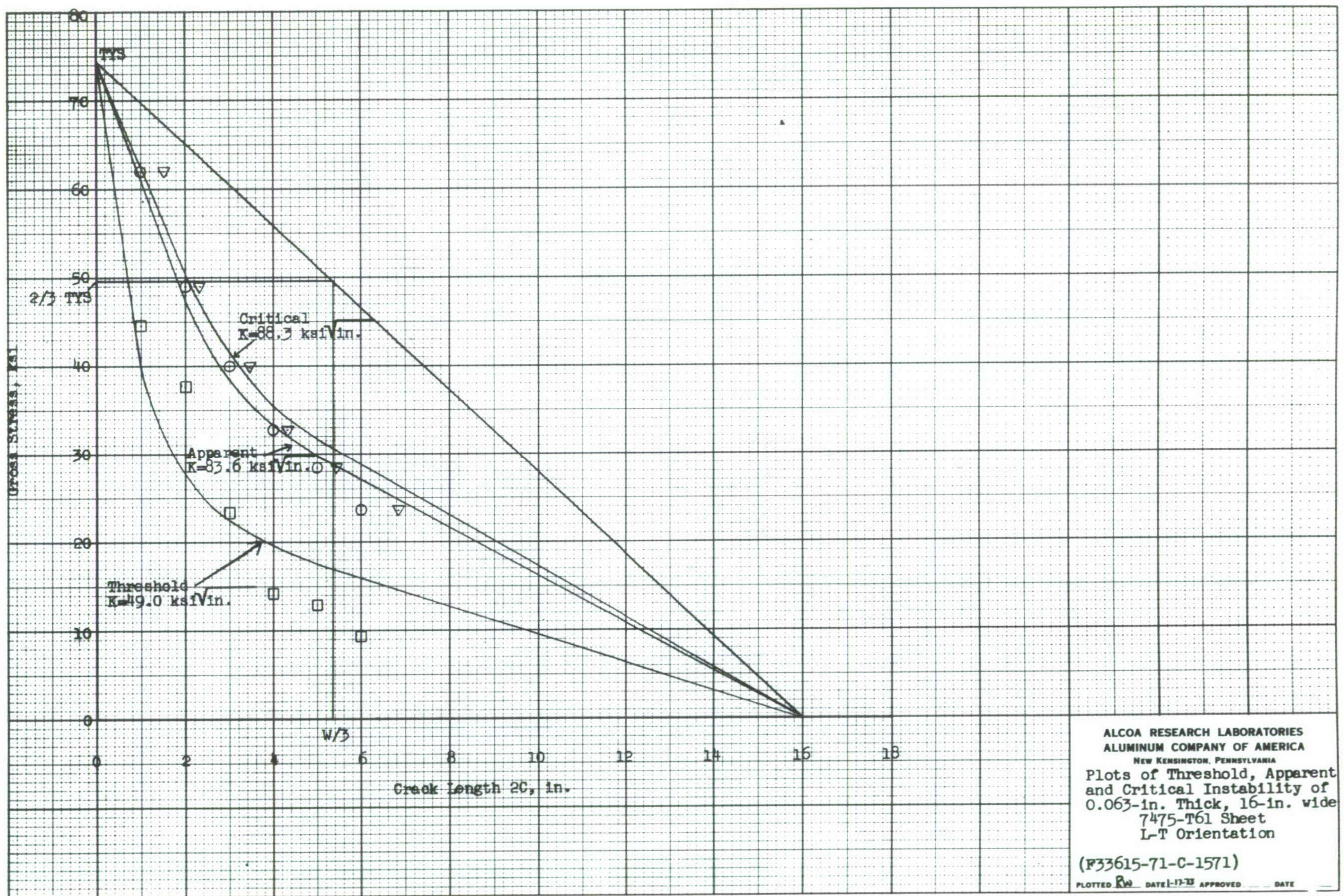

TYS
2/3 TYS
Gross Stress, ksi
Critical
K=88.3 ksi√in.
Apparent
K=83.6 ksi√in.
Threshold
K=49.0 ksi√in.
W/3
Crack Length 2C, in.
ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA
Plots of Threshold, Apparent and Critical Instability of 0.063-in. Thick, 16-in. wide 7475-T61 Sheet
L-T Orientation
(F33615-71-C-1571)
PLOTTED RW DATE 1-17-73 APPROVED DATE
Fig. 49

Fig. 49

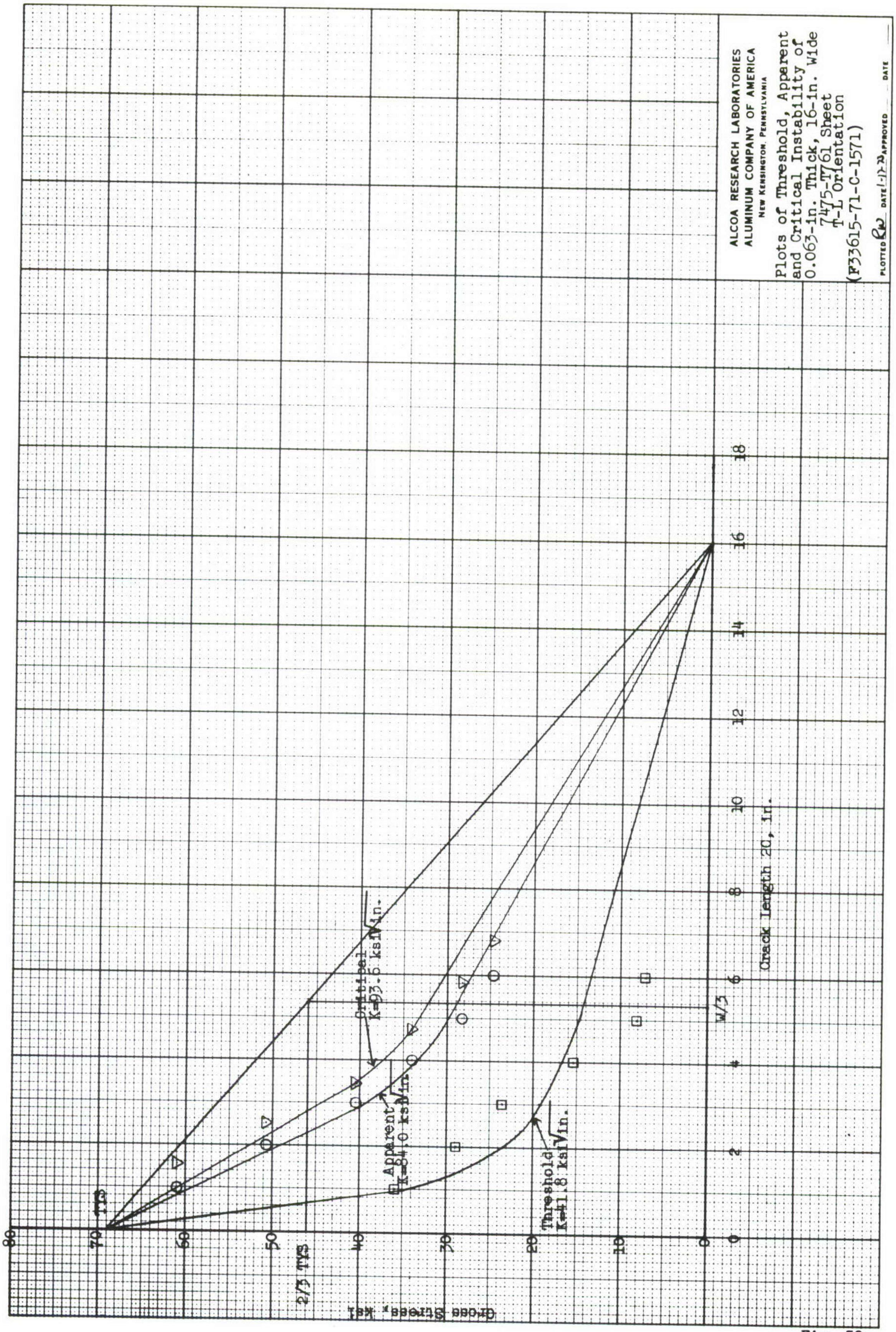
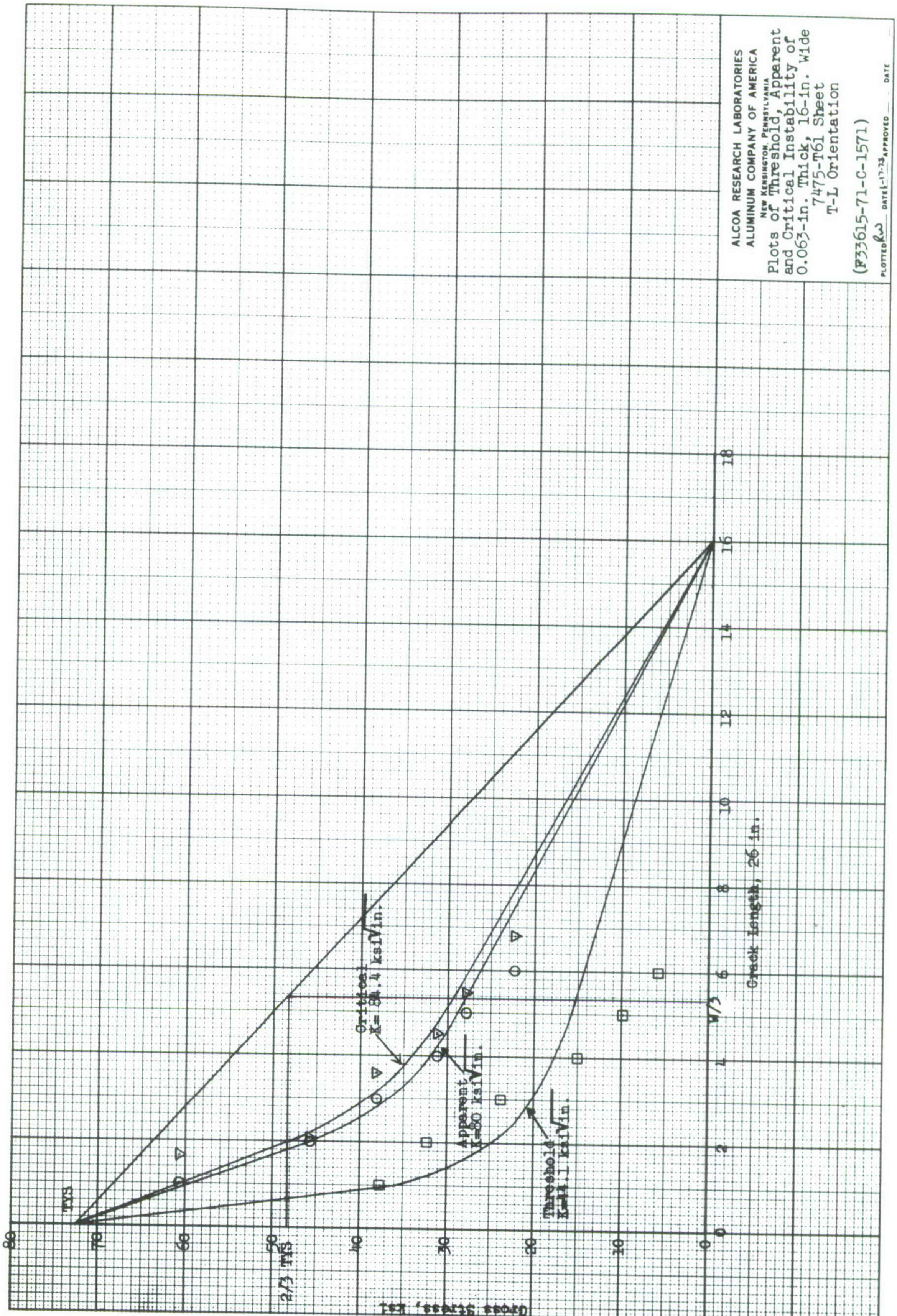

ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA
Plots of Threshold, Apparent and Critical Instability of 0.063-in. Thick, 16-in. Wide 7475-T761 Sheet T-L Orientation
(F33615-71-C-1571)
PLOTTED RW DATE APPROVED DATE
Critical K=93.5 ksi√in.
Apparent K=84.0 ksi√in.
Threshold K=41.8 ksi√in.
TYS
2/3 TYS
W/3
Gross Stress, ksi
Crack Length 2C, in.
0
2
4
6
8
10
12
14
16
18
0
10
20
30
40
50
60
70
80

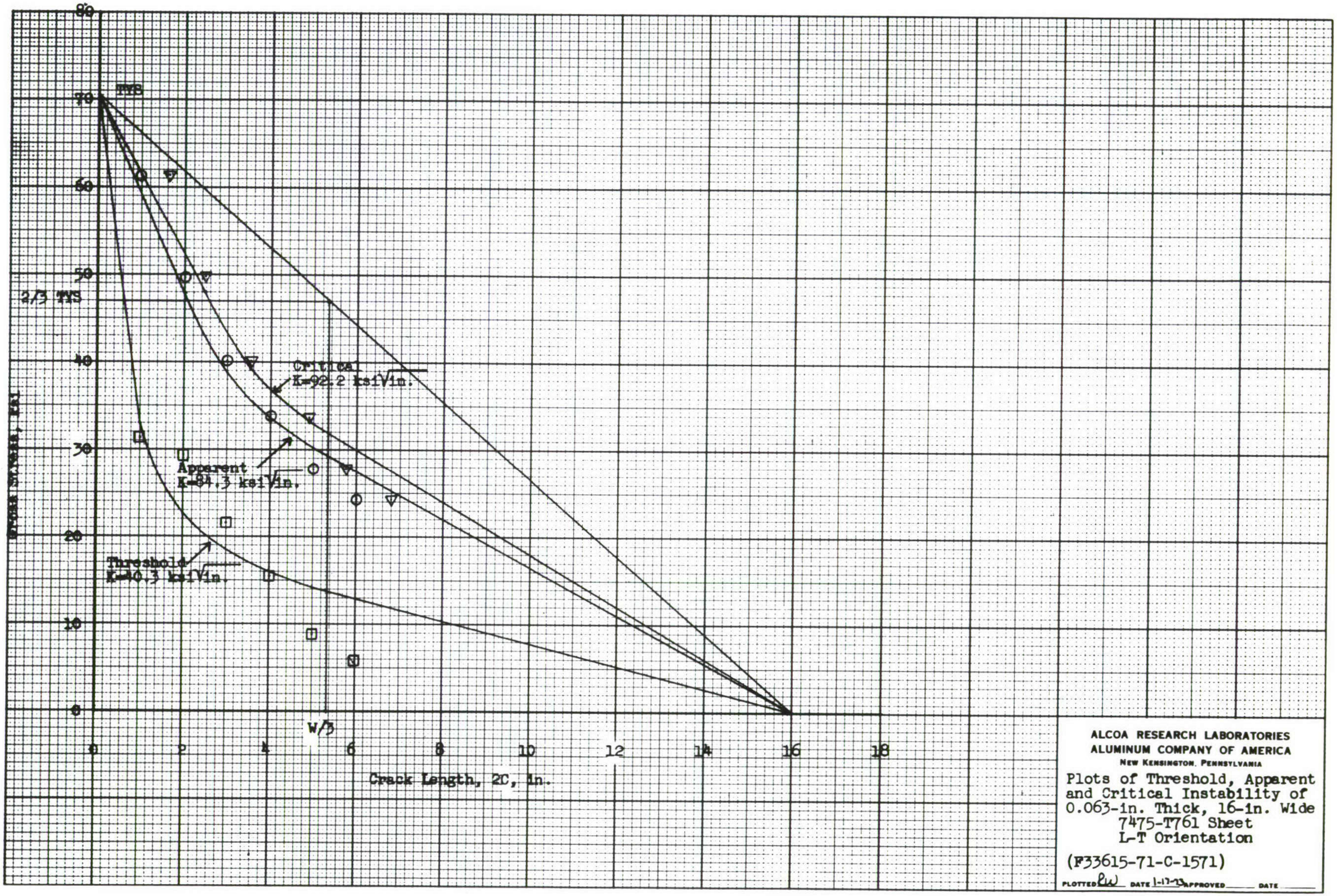
Fig. 50

Fig. 50



ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA
Plots of Threshold, Apparent and Critical Instability of 0.063-in. Thick, 16-in. Wide 7475-T61 Sheet T-L Orientation
(F33615-71-C-1571)
PLOTTED DATE APPROVED DATE
Fig. 51
Gross Stress, ksi
Crack Length, 2a in.
TYS
2/3 TYS
W/3
Critical
Apparent
Threshold

Fig. 51



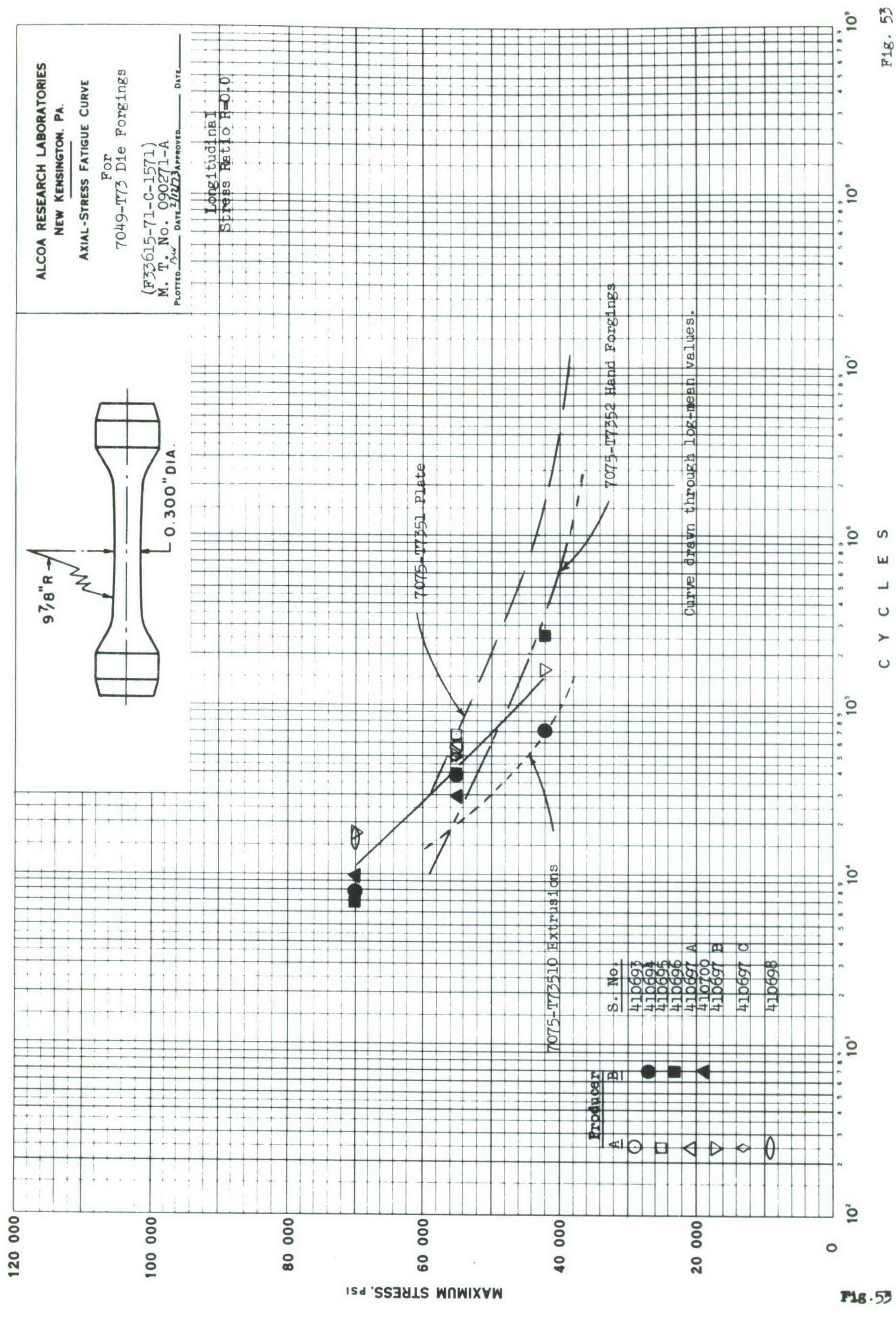
ALCOA RESEARCH LABORATORIES
ALUMINUM COMPANY OF AMERICA
NEW KENSINGTON, PENNSYLVANIA

Plots of Threshold, Apparent and Critical Instability of 0.063-in. Thick, 16-in. Wide 7475-T761 Sheet L-T Orientation

(F33615-71-C-1571)

PLOTTED RW DATE 1-17-73 APPROVED ____ DATE ____

Fig. 52



ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
For
7049-T73 Die Forgings
(F33615-71-C-1571)
M. T. No. 090271-A
Longitudinal
Stress Ratio R=0.0
9 7/8"R
0.300"DIA
7075-T7351 Plate
7075-T7352 Hand Forgings
7075-T73510 Extrusions
Curve drawn through log-mean values.
Producer
A
B
S. No.
410693
410694
410695
410696
410697 A
410700
410697 B
410697 C
410698
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES

Fig. 53

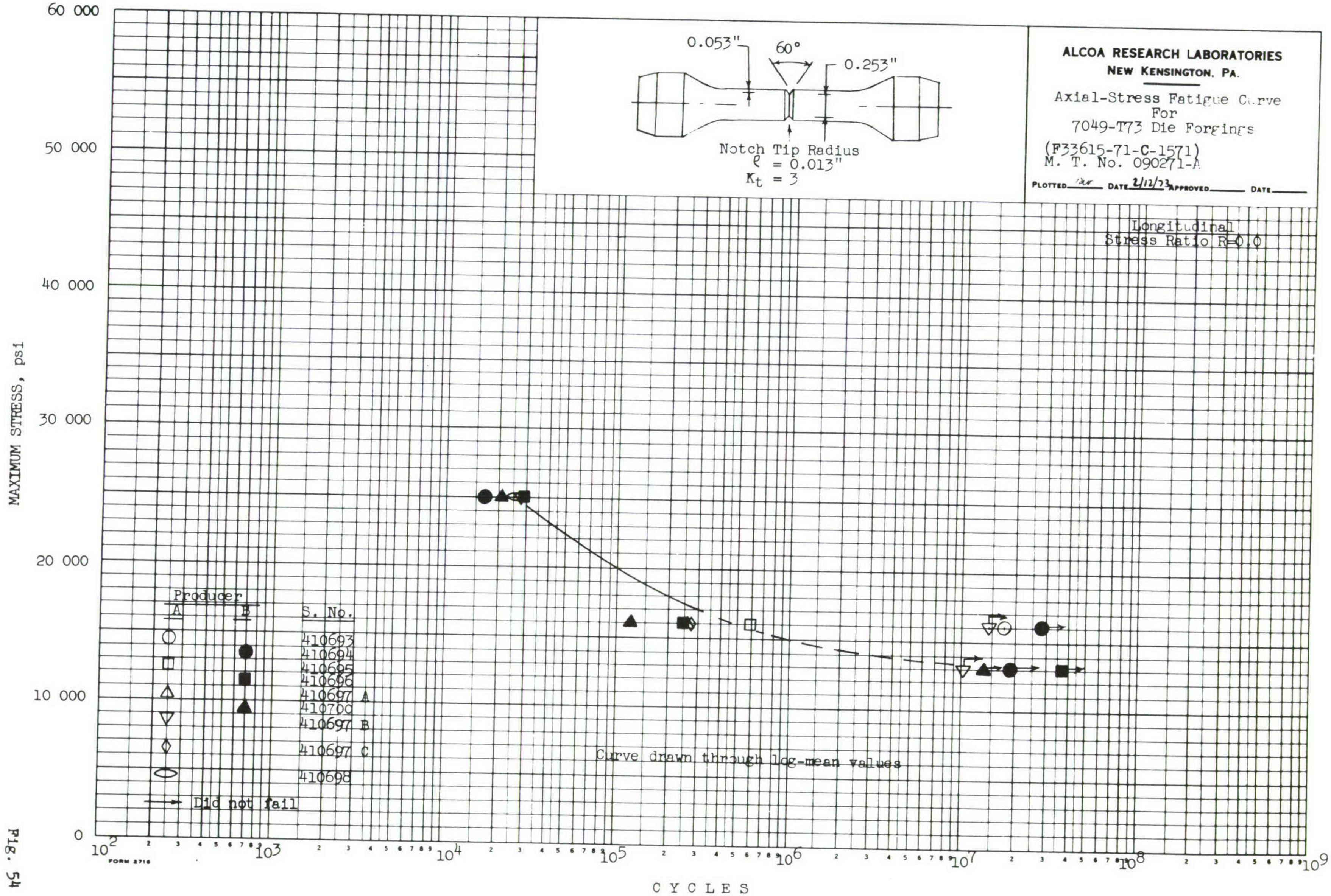

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial-Stress Fatigue Curve
For
7049-T73 Die Forgings
(F33615-71-C-1571)
M. T. No. 090271-A
PLOTTED DATE 2/12/73 APPROVED DATE
0.053"
60°
0.253"
Notch Tip Radius
ρ = 0.013"
K_t = 3
Longitudinal
Stress Ratio R=0.0
MAXIMUM STRESS, psi
60 000
50 000
40 000
30 000
20 000
10 000
0
Producer
A
B
S. No.
410693
410694
410695
410696
410697 A
410700
410697 B
410697 C
410698
Did not fail
Curve drawn through log-mean values
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
CYCLES
FORM 2716
Fig. 54

Fig. 54

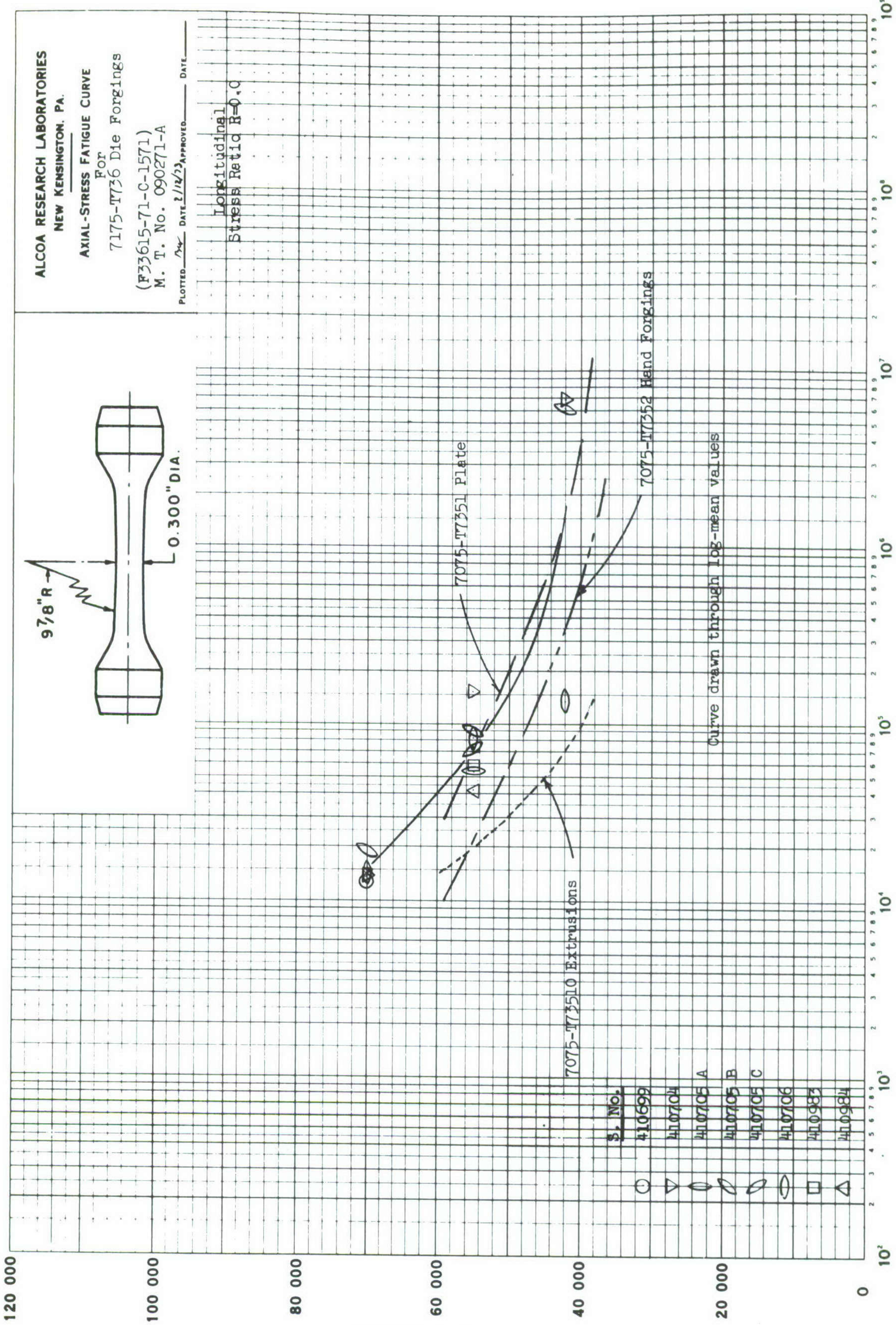

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
For
7175-T736 Die Forgings
(F33615-71-C-1571)
M. T. No. 090271-A
PLOTTED DATE 2/12/73 APPROVED DATE
Longitudinal
Stress Ratio R=0.0
9 7/8" R
0.300" DIA.
7075-T7351 Plate
7075-T7352 Hand Forgings
Curve drawn through log-mean values
7075-T73510 Extrusions
S. No.
410699
410704
410705 A
410705 B
410705 C
410706
410983
410984
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES

Fig. 55

Fig. 55

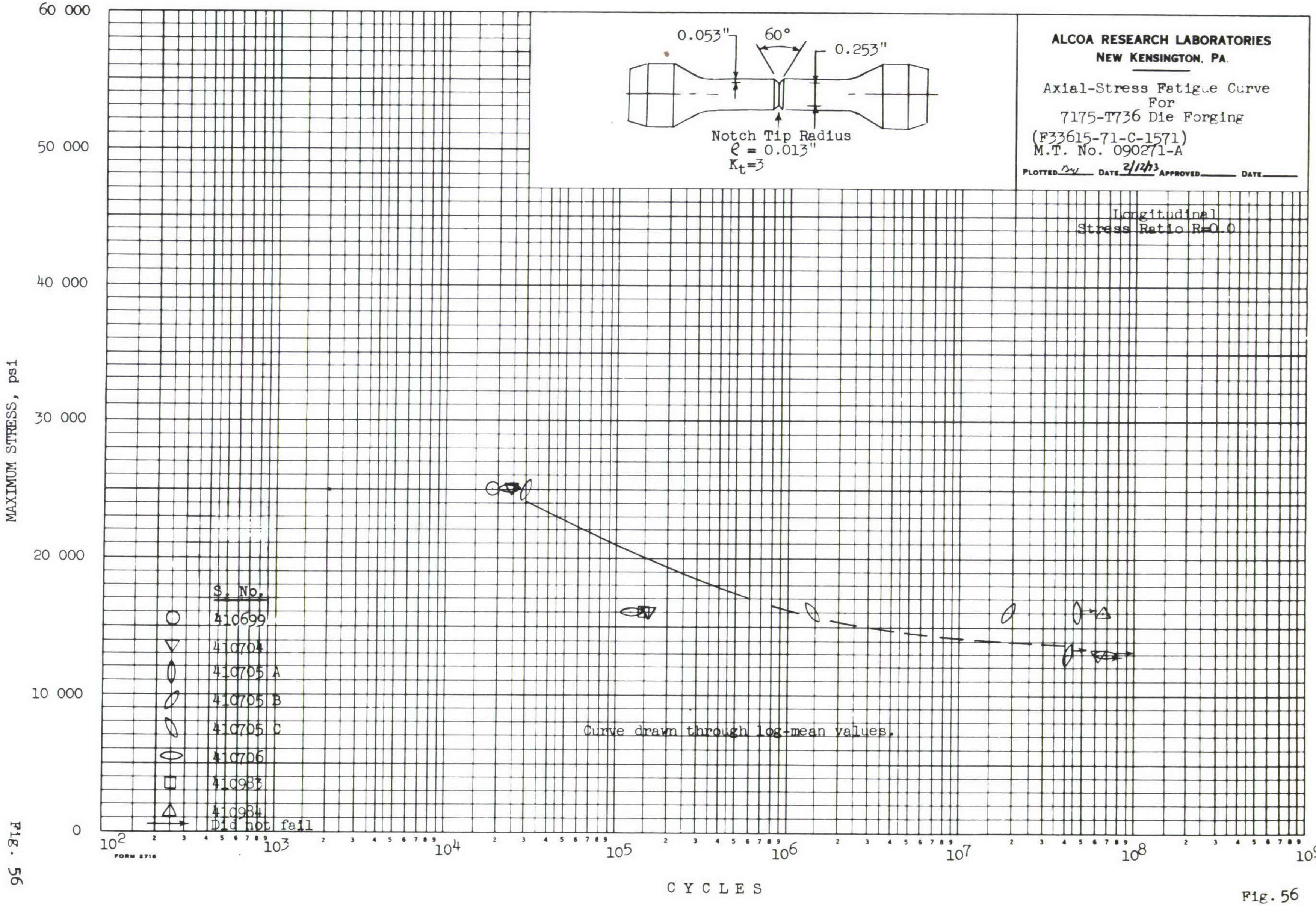

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial-Stress Fatigue Curve
For
7175-T736 Die Forging
(F33615-71-C-1571)
M.T. No. 090271-A
PLOTTED
DATE 2/12/73
APPROVED
DATE
0.053"
60°
0.253"
Notch Tip Radius
ρ = 0.013"
Kt=3
Longitudinal
Stress Ratio R=0.0
S. No.
410699
410704
410705 A
410705 B
410705 C
410706
410983
410984
Did not fail
Curve drawn through log-mean values.
MAXIMUM STRESS, psi
60 000
50 000
40 000
30 000
20 000
10 000
0
CYCLES
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
FORM 2716

Fig. 56

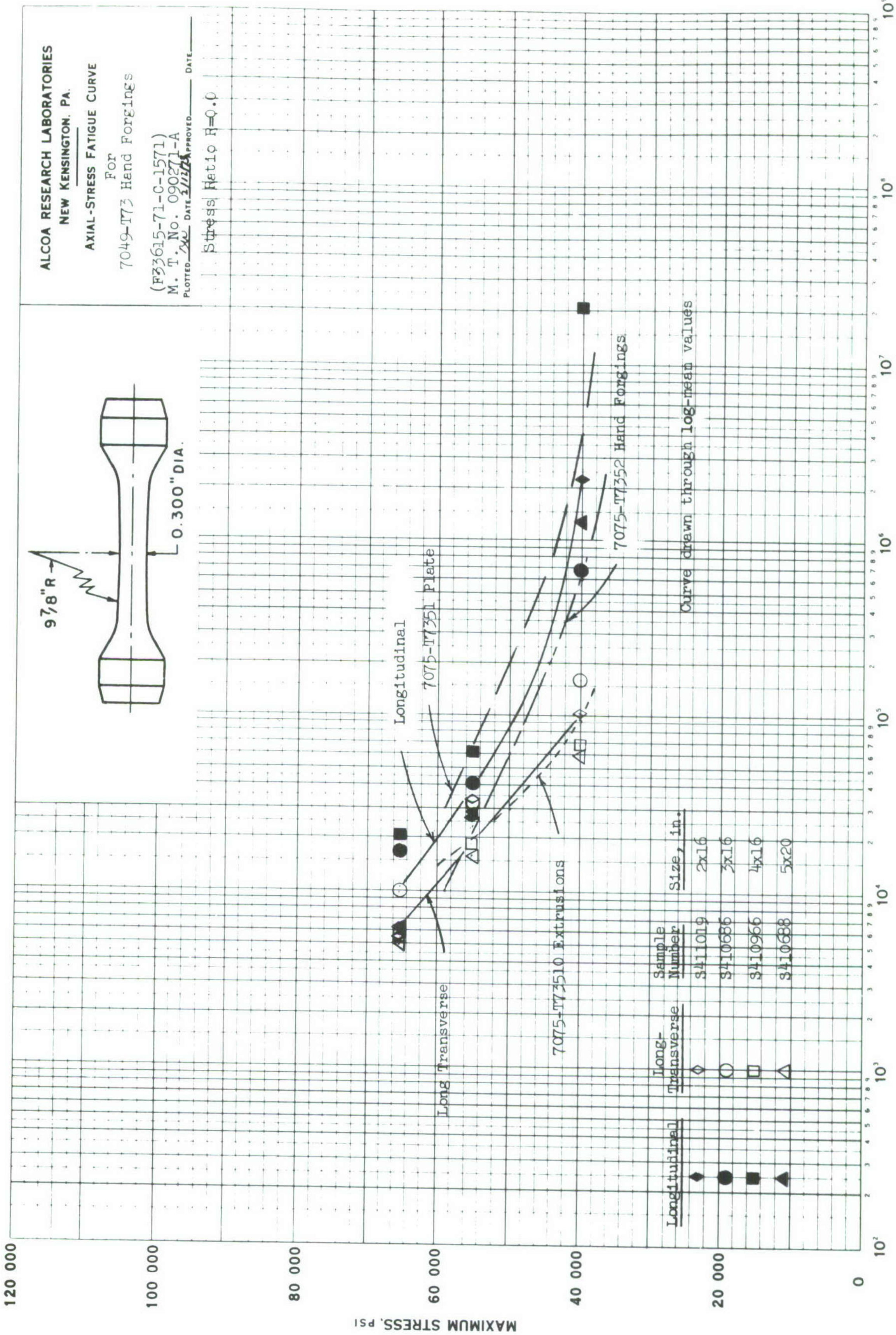
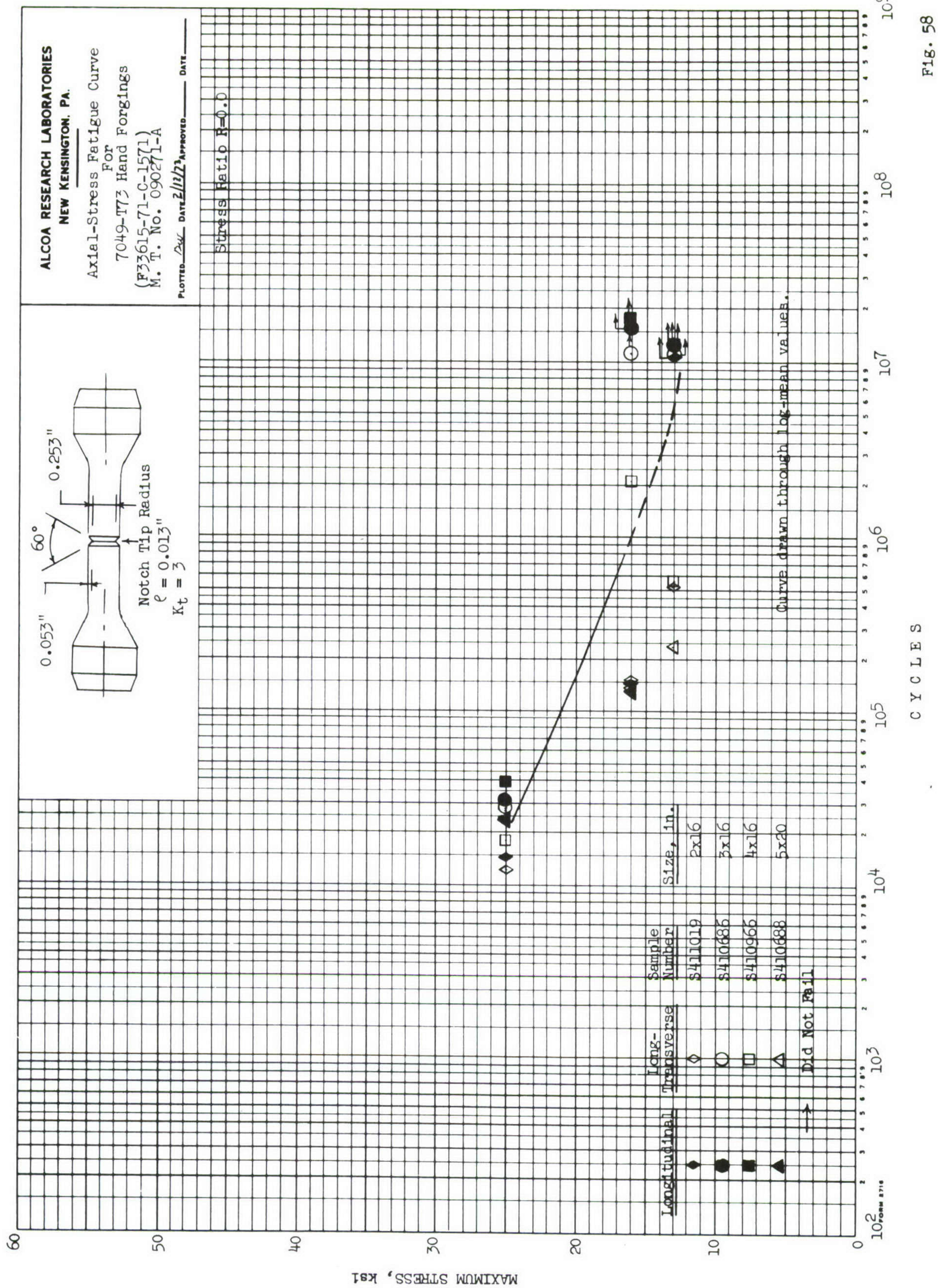

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
For
7049-T73 Hand Forgings
(F33615-71-C-1571)
M. T. No. 090271-A
Stress Ratio R=0.0
9 7/8"R
0.300"DIA.
Longitudinal
7075-T7351 Plate
7075-T7352 Hand Forgings
Long Transverse
7075-T73510 Extrusions
Curve drawn through log-mean values
Longitudinal
Long-Transverse
Sample Number
Size, in.
S411019
2x16
S410686
3x16
S410966
4x16
S410688
5x20
MAXIMUM STRESS, PSI
CYCLES

Fig. 57

Fig. 57



ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial-Stress Fatigue Curve
For
7049-T73 Hand Forgings
(F33615-71-C-1571)
M. T. No. 090271-A
Stress Ratio R=0.0
0.053"
0.253"
60°
Notch Tip Radius
ρ = 0.013"
Kt = 3
Longitudinal
Long-Transverse
Sample Number
Size, in.
S411019
2x16
S410686
3x16
S410966
4x16
S410688
5x20
Did Not Fail
Curve drawn through log-mean values.
MAXIMUM STRESS, ksi
CYCLES
Fig. 58

Fig. 58

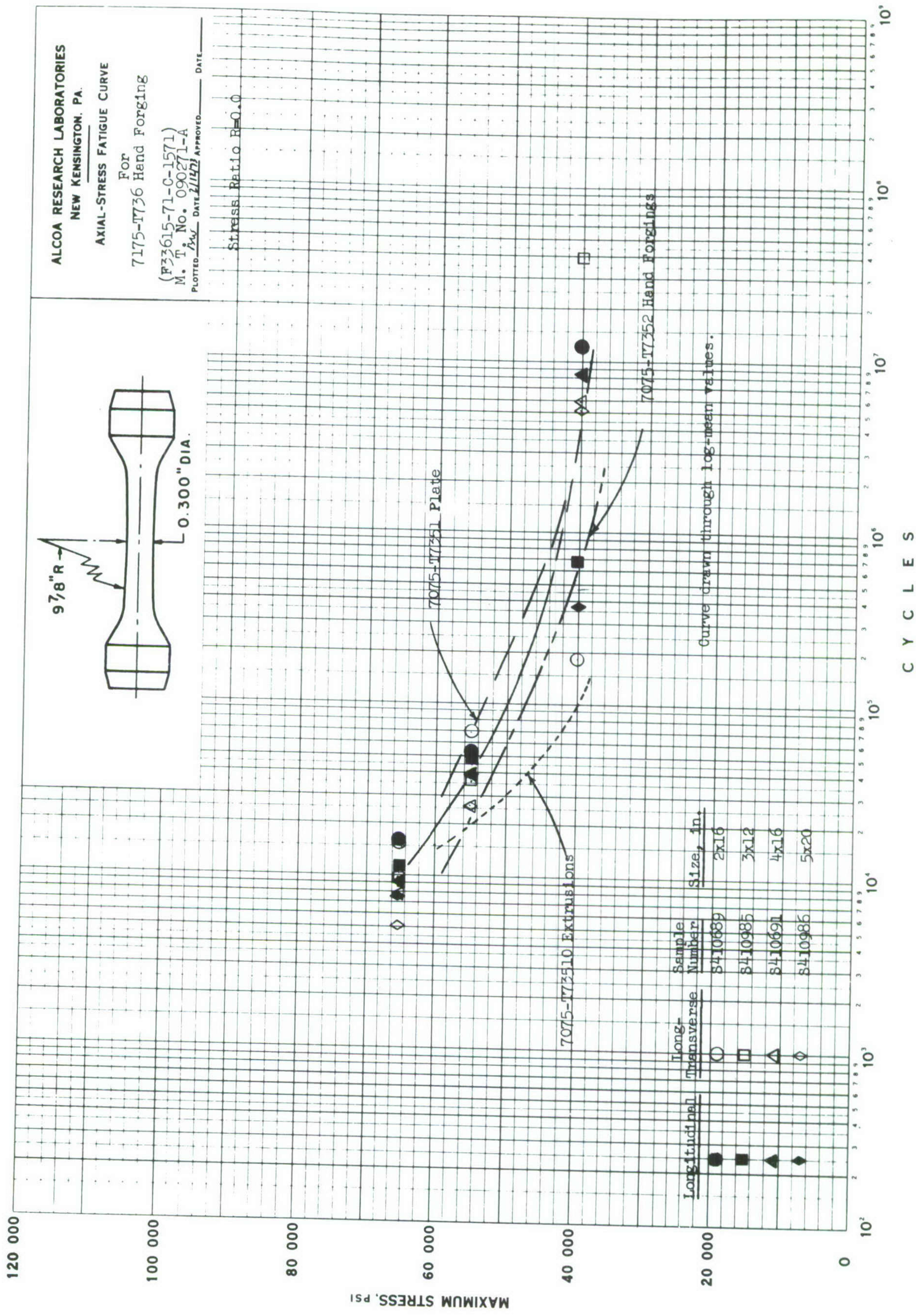

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
For
7175-T736 Hand Forging
(F33615-71-C-1571)
M. T. No. 090271-A
Stress Ratio R=0.0
9 7/8" R
0.300" DIA
7075-T7351 Plate
7075-T7352 Hand Forgings
7075-T73510 Extrusions
Curve drawn through log-mean values.
Longitudinal
Long-Transverse
Sample Number
Size, in.
S410689
S410985
S410691
S410986
2x16
3x12
4x16
5x20
MAXIMUM STRESS, PSI
0
20 000
40 000
60 000
80 000
100 000
120 000
CYCLES
Fig. 59

Fig.59

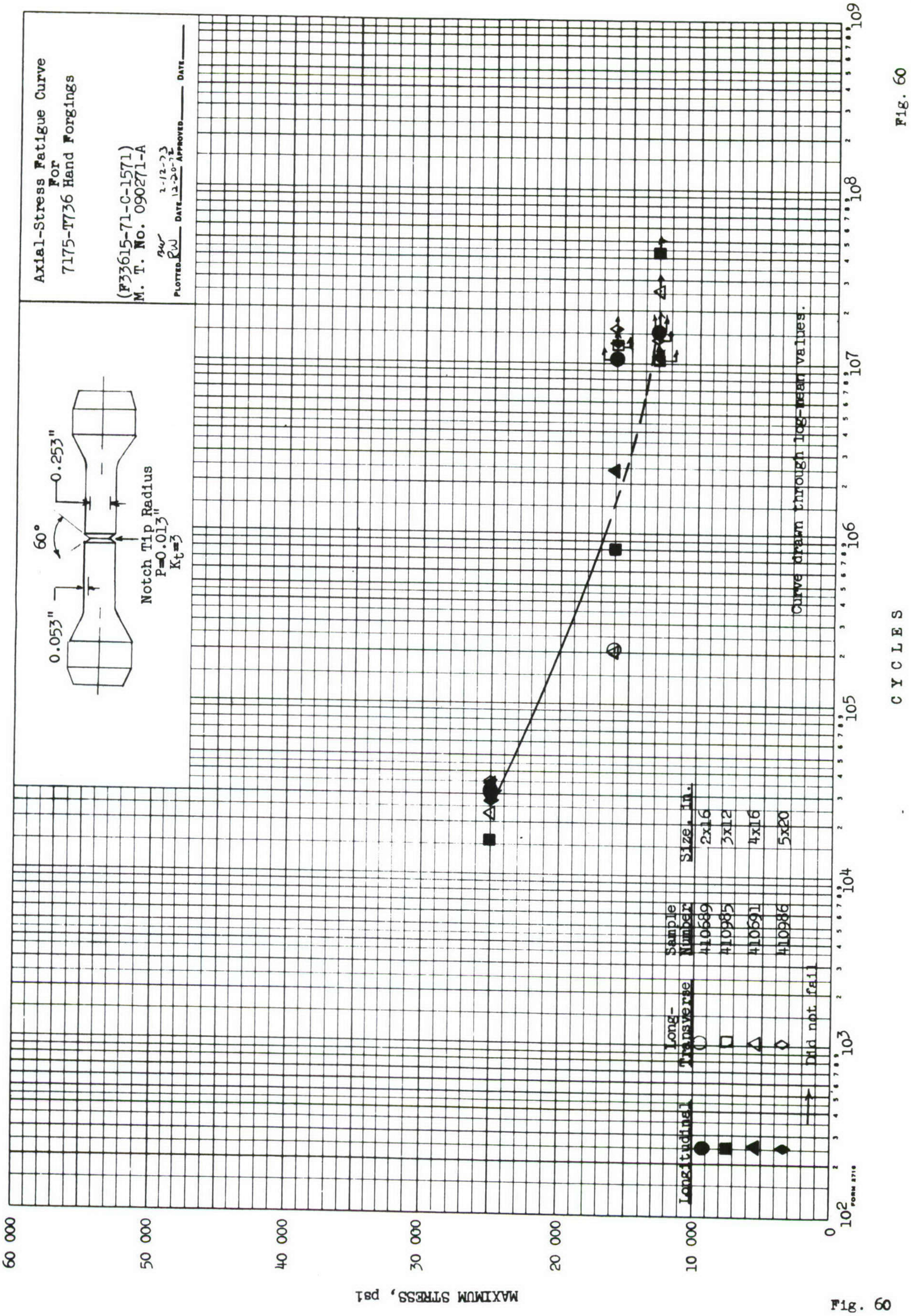
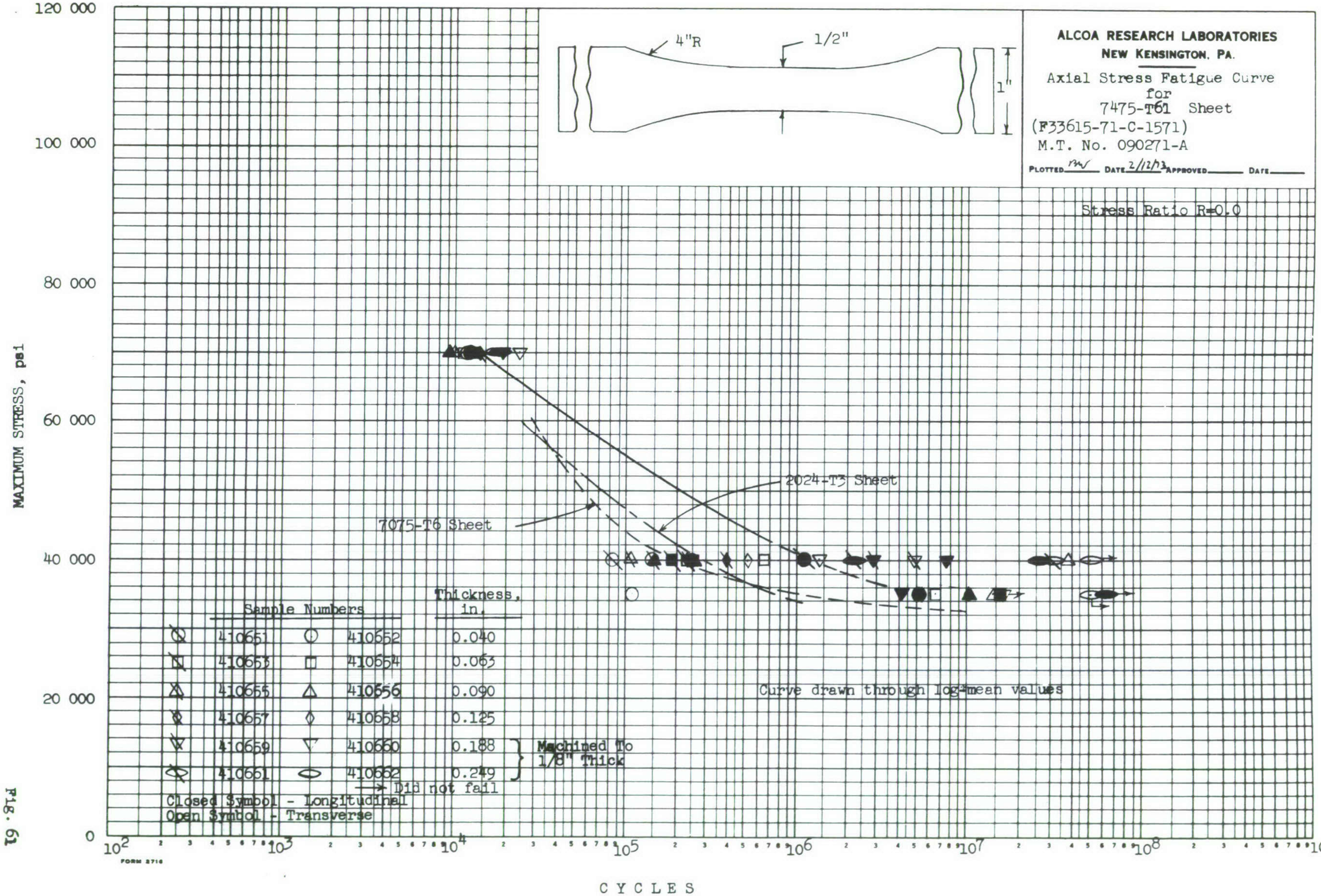

Axial-Stress Fatigue Curve
For
7175-T736 Hand Forgings
(F33615-71-C-1571)
M. T. No. 090271-A
PLOTTED RW DATE 12-20-72 APPROVED DATE
0.053"
0.253"
60°
Notch Tip Radius
P=0.013"
K_t=3
Longitudinal
Long-Transverse
Sample Number
Size, In.
410689
2x16
410985
3x12
410691
4x16
410986
5x20
Did not fail
Curve drawn through log-mean values.
MAXIMUM STRESS, psi
60 000
50 000
40 000
30 000
20 000
10 000
0
CYCLES
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
Fig. 60

Fig. 60



ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial Stress Fatigue Curve
for
7475-T61 Sheet
(F33615-71-C-1571)
M.T. No. 090271-A
PLOTTED DATE 2/12/73 APPROVED DATE
4"R
1/2"
1"
Stress Ratio R=0.0
2024-T3 Sheet
7075-T6 Sheet
Curve drawn through log-mean values
Sample Numbers
Thickness, in.
410651 410652 0.040
410653 410654 0.063
410655 410656 0.090
410657 410658 0.125
410659 410660 0.188
410661 410662 0.249
Machined To 1/8" Thick
→ Did not fail
Closed Symbol - Longitudinal
Open Symbol - Transverse
MAXIMUM STRESS, psi
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES
FORM 2716

Fig. 61

Fig. 61

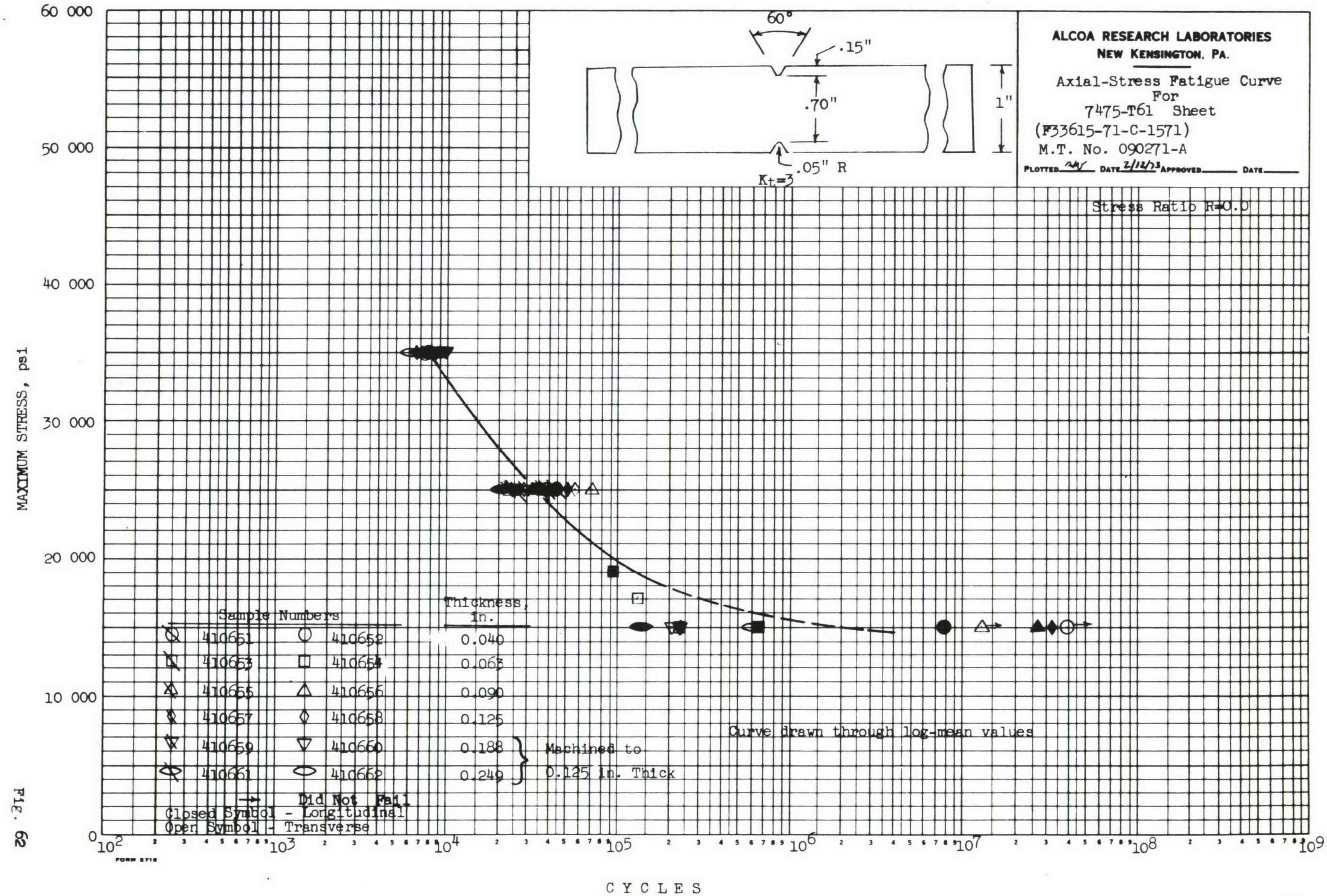

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial-Stress Fatigue Curve
For
7475-T61 Sheet
(F33615-71-C-1571)
M.T. No. 090271-A
PLOTTED ____ DATE 2/12/73 APPROVED ____ DATE ____
60°
.15"
.70"
1"
.05" R
K_t=3
Stress Ratio R=0.0
MAXIMUM STRESS, psi
60 000
50 000
40 000
30 000
20 000
10 000
0
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
CYCLES
Sample Numbers
410651
410652
410653
410654
410655
410656
410657
410658
410659
410660
410661
410662
Thickness, in.
0.040
0.063
0.090
0.125
0.188
0.249
Machined to 0.125 in. Thick
Did Not Fail
Closed Symbol - Longitudinal
Open Symbol - Transverse
Curve drawn through log-mean values
FORM 2716

Fig. 62

Fig. 62

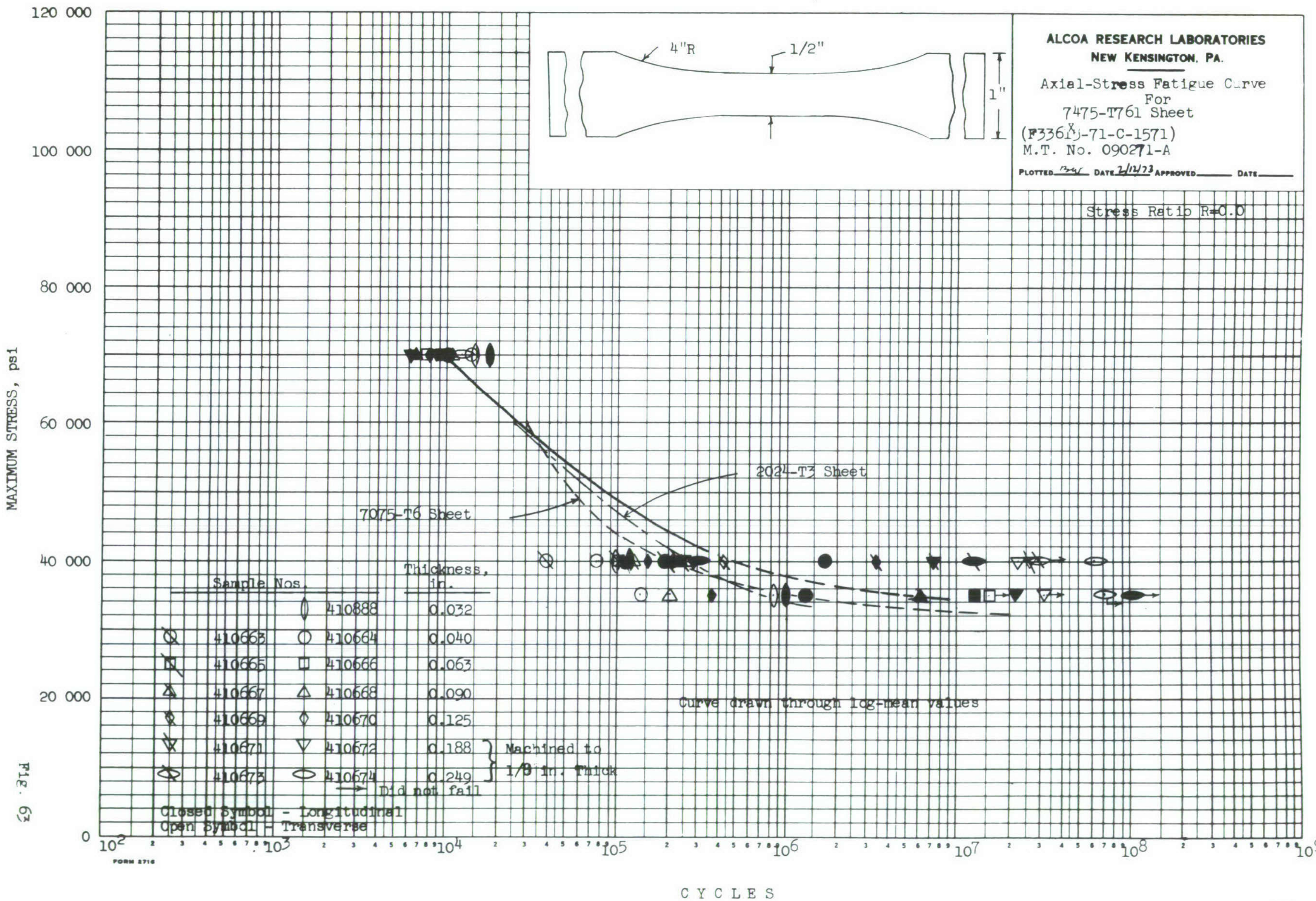

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial-Stress Fatigue Curve
For
7475-T761 Sheet
(F33615-71-C-1571)
M.T. No. 090271-A
PLOTTED DATE APPROVED DATE
4"R
1/2"
1"
Stress Ratio R=0.0
MAXIMUM STRESS, psi
120 000
100 000
80 000
60 000
40 000
20 000
0
2024-T3 Sheet
7075-T6 Sheet
Sample Nos.
Thickness, in.
410888 0.032
410663 410664 0.040
410665 410666 0.063
410667 410668 0.090
410669 410670 0.125
410671 410672 0.188
410673 410674 0.249
Machined to 1/8 in. Thick
Did not fail
Closed Symbol - Longitudinal
Open Symbol - Transverse
Curve drawn through log-mean values
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
CYCLES
FORM 2716

Fig. 63

Fig. 63

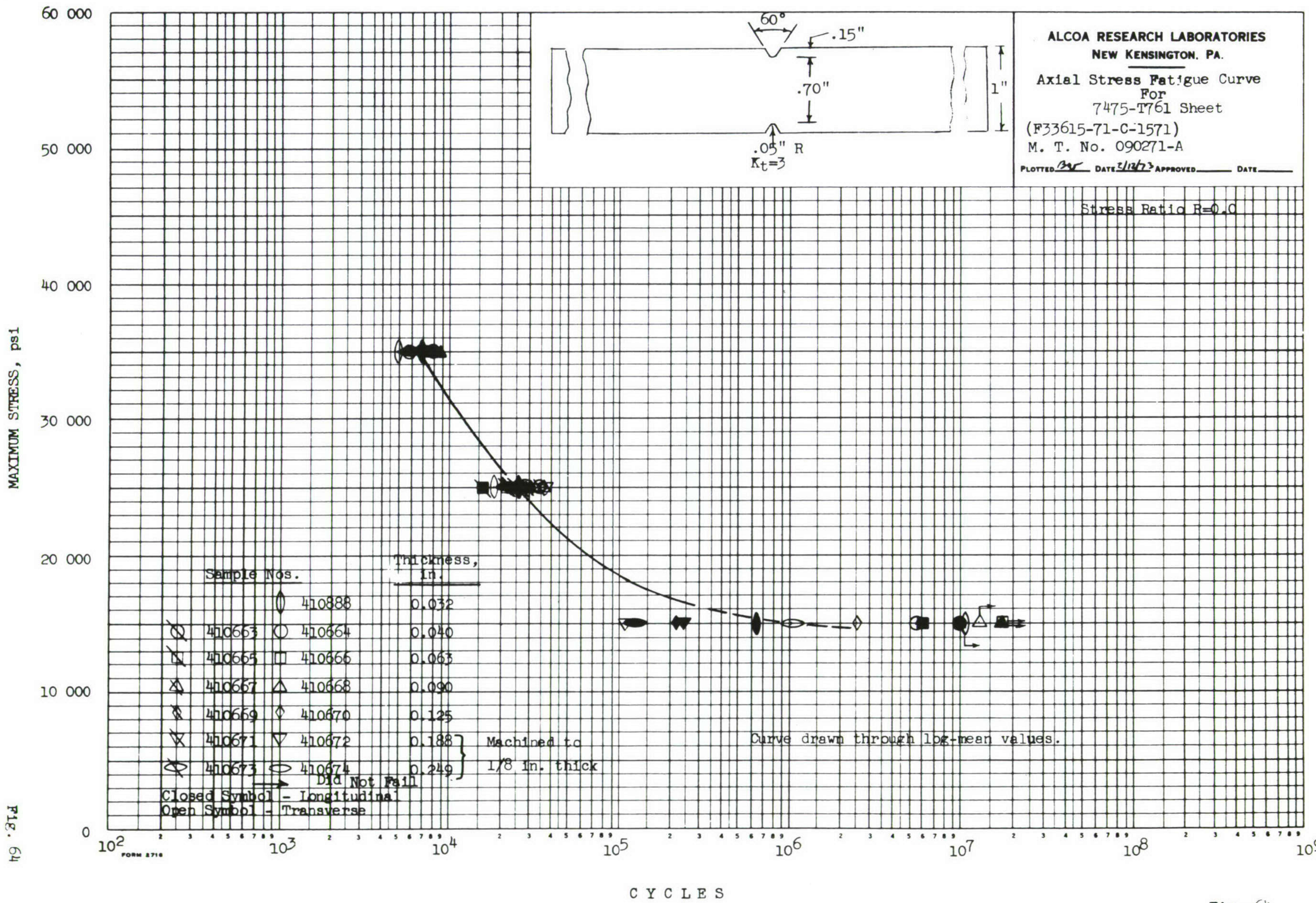
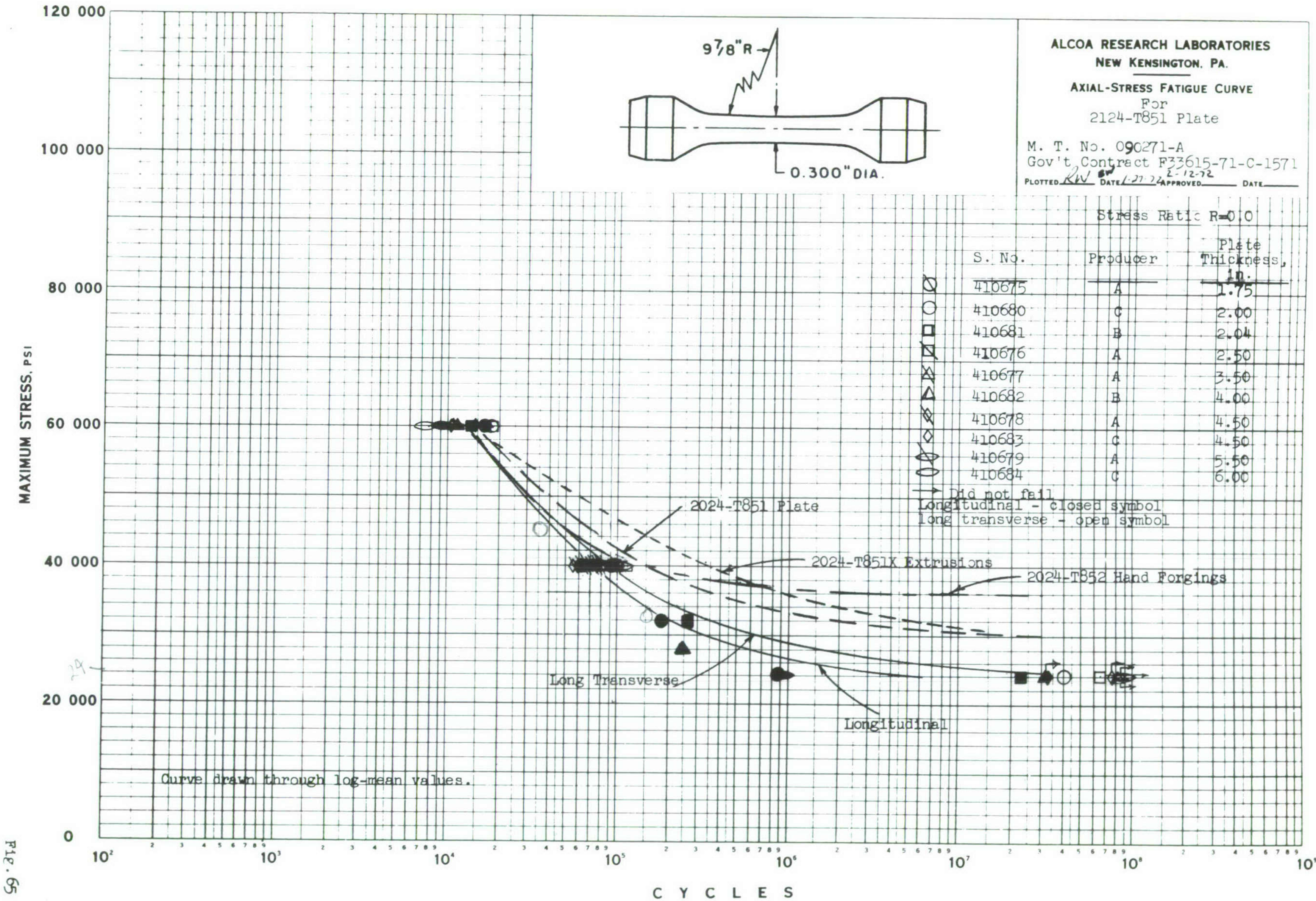

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Axial Stress Fatigue Curve
For
7475-T761 Sheet
(F33615-71-C-1571)
M. T. No. 090271-A
PLOTTED BJW DATE 2/13/73 APPROVED DATE
60°
.15"
.70"
1"
.05" R
$K_t=3$
Stress Ratio R=0.0
MAXIMUM STRESS, psi
60 000
50 000
40 000
30 000
20 000
10 000
0
Sample Nos.
Thickness, in.
410888 0.032
410663 410664 0.040
410665 410666 0.063
410667 410668 0.090
410669 410670 0.125
410671 410672 0.188
410673 410674 0.249
Machined to 1/8 in. thick
Did Not Fail
Closed Symbol - Longitudinal
Open Symbol - Transverse
Curve drawn through log-mean values.
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
FORM 2716
CYCLES

Fig. 64



ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL-STRESS FATIGUE CURVE
For
2124-T851 Plate
M. T. No. 090271-A
Gov't Contract F33615-71-C-1571
PLOTTED RW DATE 1-27-72 APPROVED 2-12-72 DATE
9 7/8"R
0.300" DIA.
Stress Ratio R=0.0
S. No. | Producer | Plate Thickness, in.
410675 | A | 1.75
410680 | C | 2.00
410681 | B | 2.04
410676 | A | 2.50
410677 | A | 3.50
410682 | B | 4.00
410678 | A | 4.50
410683 | C | 4.50
410679 | A | 5.50
410684 | C | 6.00
Did not fail
Longitudinal - closed symbol
long transverse - open symbol
2024-T851 Plate
2024-T851X Extrusions
2024-T852 Hand Forgings
Long Transverse
Longitudinal
Curve drawn through log-mean values.
MAXIMUM STRESS, PSI
120 000
100 000
80 000
60 000
40 000
20 000
0
CYCLES
10^2
10^3
10^4
10^5
10^6
10^7
10^8
10^9
29

Fig. 65

Fig. 65

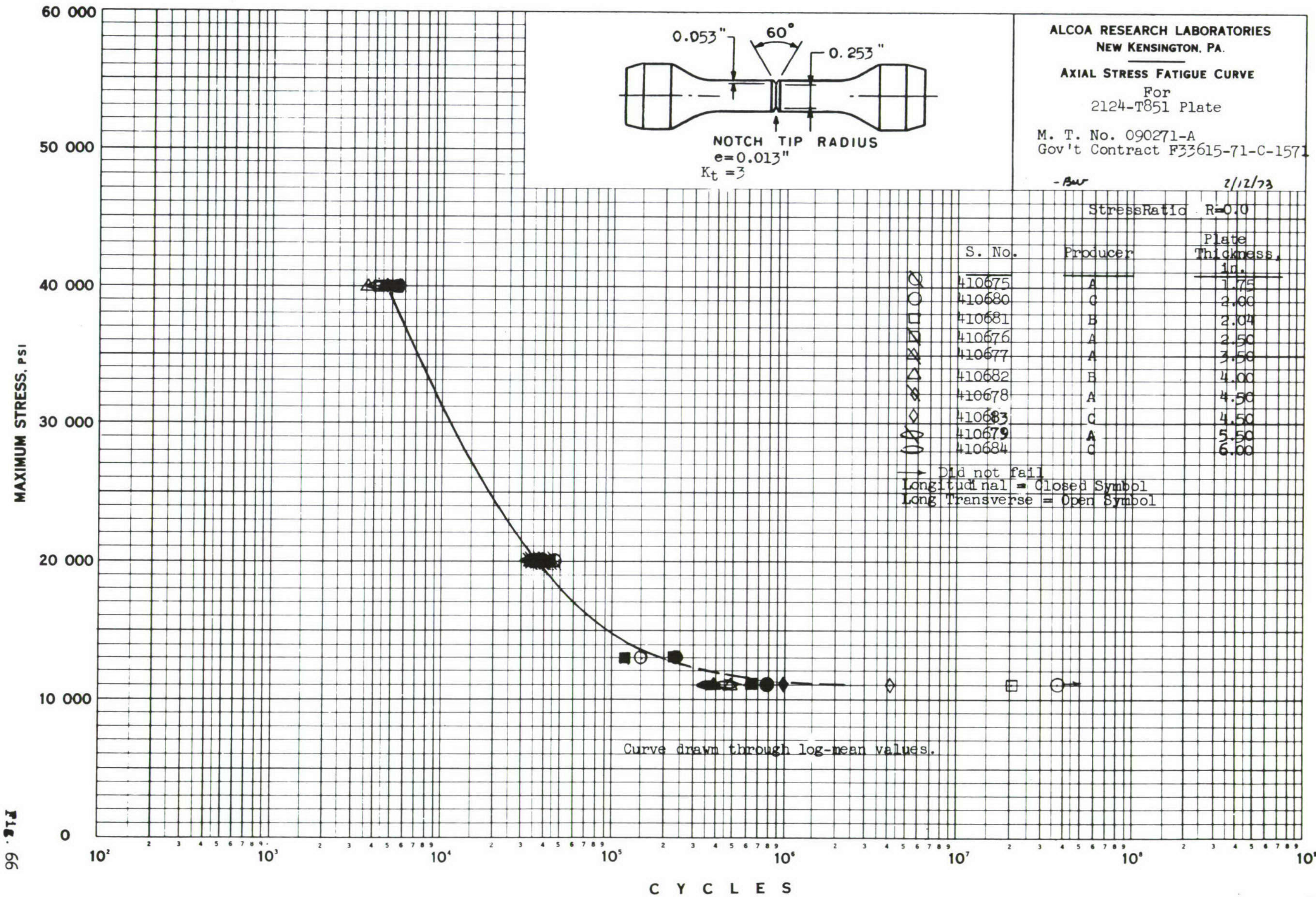

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
AXIAL STRESS FATIGUE CURVE
For
2124-T851 Plate
M. T. No. 090271-A
Gov't Contract F33615-71-C-1571
2/12/73
0.053"
60°
0.253"
NOTCH TIP RADIUS
e=0.013"
Kt =3
Stress Ratio R=0.0
S. No.
Producer
Plate Thickness, in.
410675 A 1.75
410680 C 2.00
410681 B 2.04
410676 A 2.50
410677 A 3.50
410682 B 4.00
410678 A 4.50
410683 C 4.50
410679 A 5.50
410684 C 6.00
Did not fail
Longitudinal = Closed Symbol
Long Transverse = Open Symbol
Curve drawn through log-mean values.
MAXIMUM STRESS, PSI
60 000
50 000
40 000
30 000
20 000
10 000
0
10²
10³
10⁴
10⁵
10⁶
10⁷
10⁸
10⁹
CYCLES

Fig. 66

Fig. 66

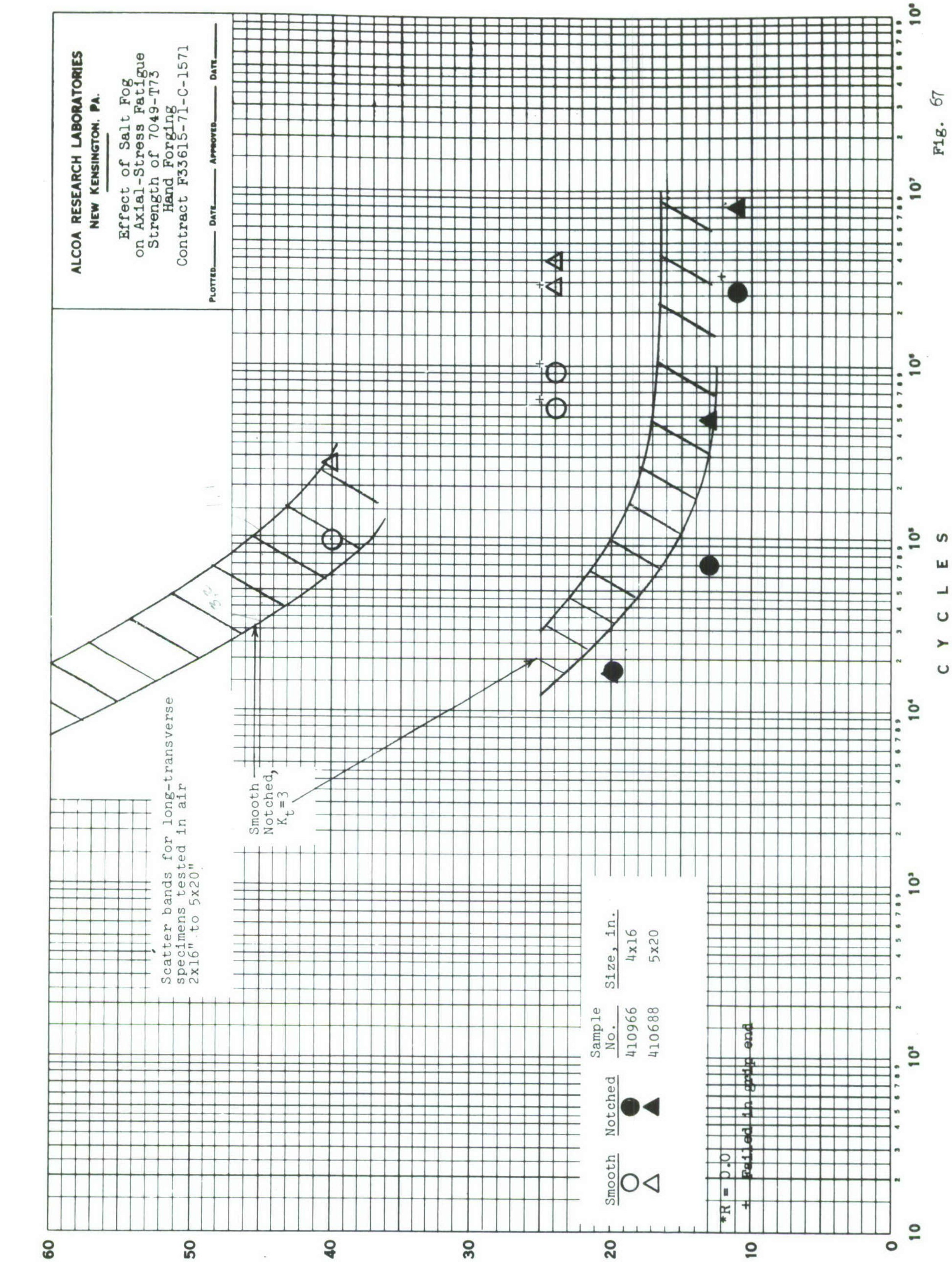
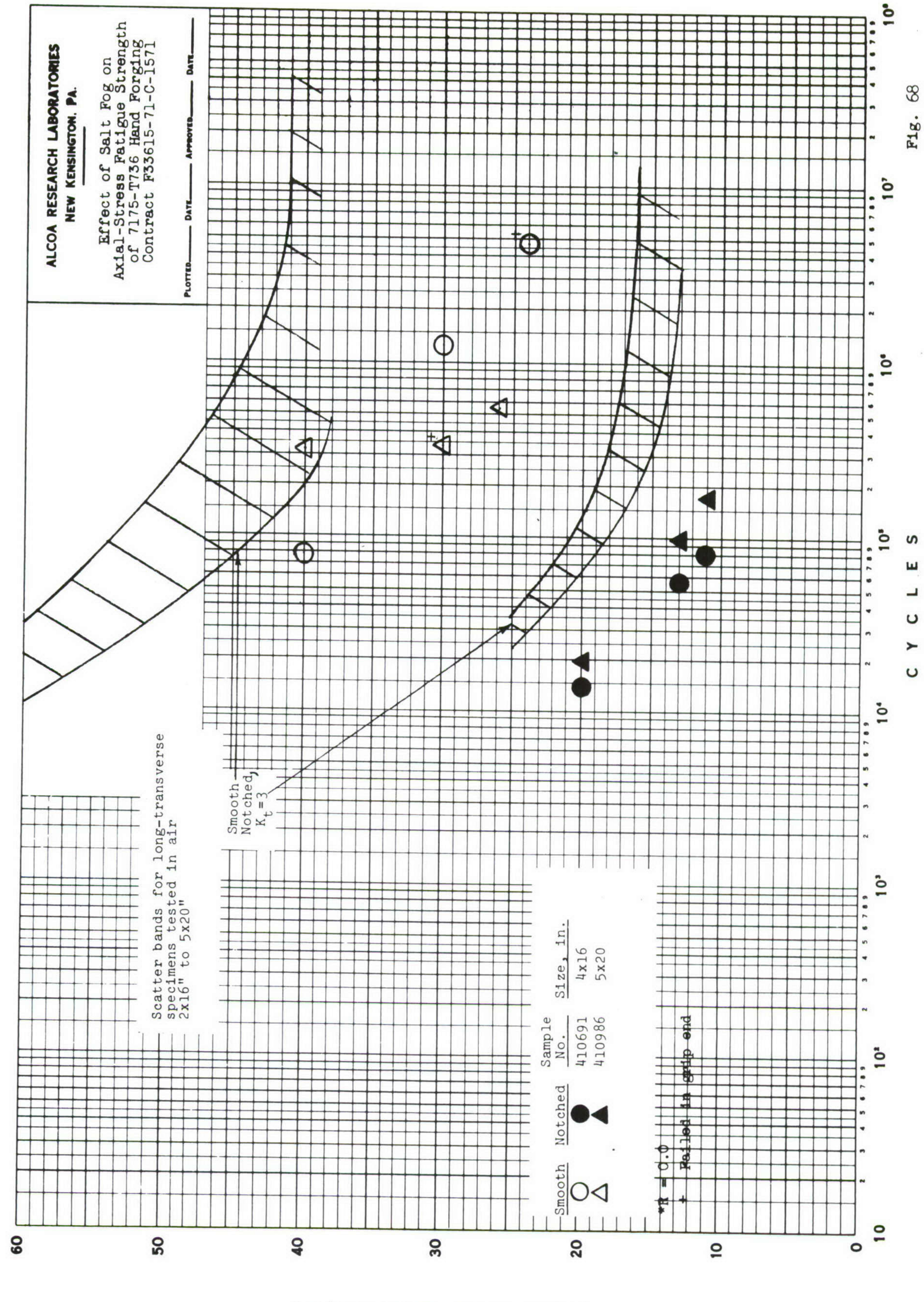

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Effect of Salt Fog
on Axial-Stress Fatigue
Strength of 7049-T73
Hand Forging
Contract F33615-71-C-1571
PLOTTED ____ DATE ____ APPROVED ____ DATE ____
Fig. 67
Scatter bands for long-transverse
specimens tested in air
2x16" to 5x20"
Smooth
Notched,
$K_t = 3$
Smooth | Notched | Sample No. | Size, in.
○ | ● | 410966 | 4x16
△ | ▲ | 410688 | 5x20
*R = 0.0
+ Failed in grip end
60
50
40
30
20
10
0
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
C Y C L E S
MAXIMUM (P/A) STRESS IN CYCLE,* KSI
FORM 120 - 9C - 12/64

Fig. 67


ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Effect of Salt Fog on Axial-Stress Fatigue Strength of 7175-T736 Hand Forging
Contract F33615-71-C-1571
PLOTTED ____ DATE ____ APPROVED ____ DATE ____
Fig. 68
Scatter bands for long-transverse specimens tested in air 2x16" to 5x20"
Smooth
Notched, $K_t=3$
Smooth
Notched
Sample No.
Size, in.
410691
4x16
410986
5x20
*R = 0.0
+ Failed in grip end
MAXIMUM (P/A) STRESS IN CYCLE,* KSI
0
10
20
30
40
50
60
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
C Y C L E S
FORM 120 - SC - 12/64
Fig. 68

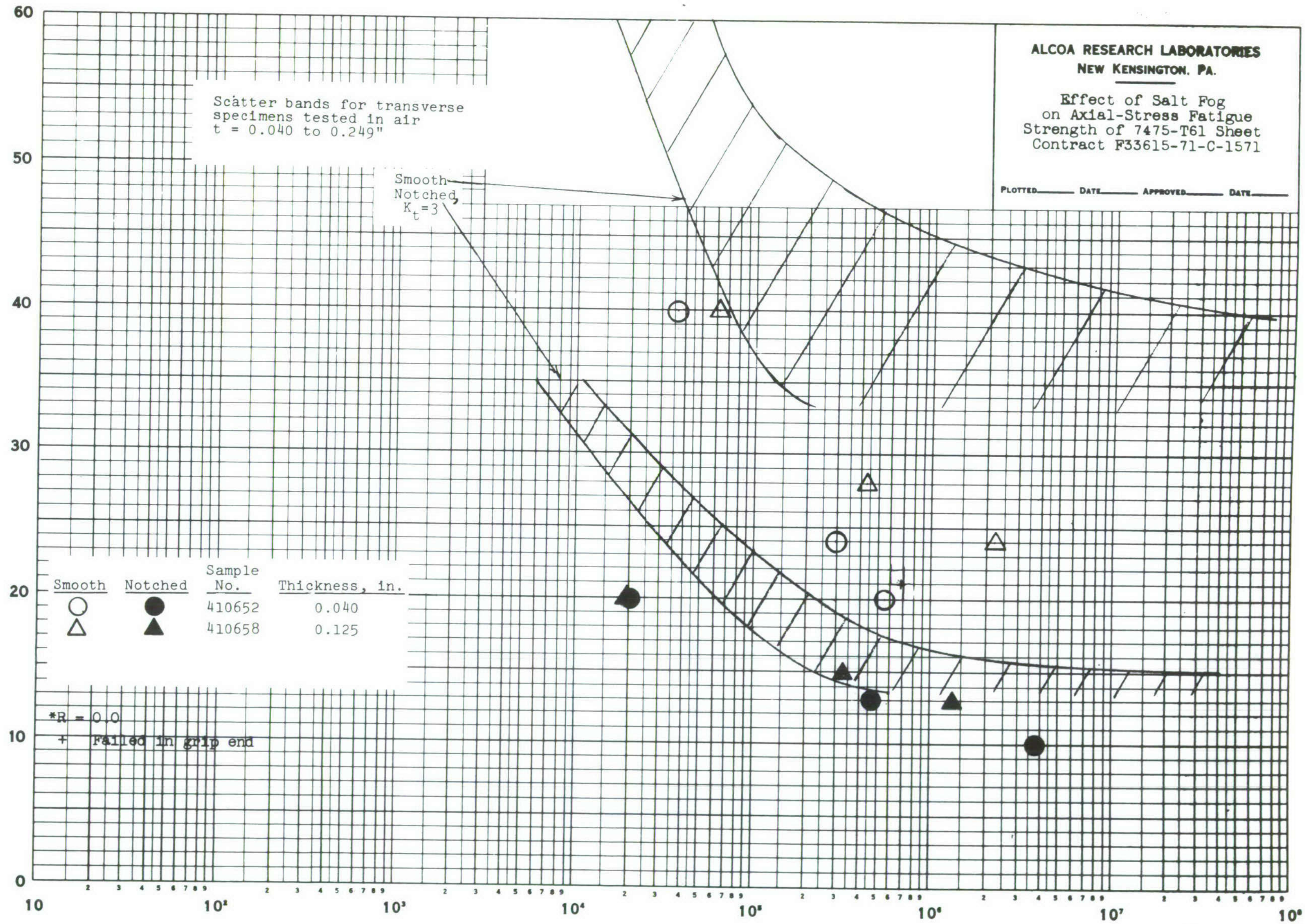

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Effect of Salt Fog on Axial-Stress Fatigue Strength of 7475-T61 Sheet
Contract F33615-71-C-1571
PLOTTED DATE APPROVED DATE
Scatter bands for transverse specimens tested in air t = 0.040 to 0.249"
Smooth
Notched, $K_t = 3$
Smooth Notched Sample No. Thickness, in.
410652 0.040
410658 0.125
*R = 0.0
+ Failed in grip end
MAXIMUM (P/A) STRESS IN CYCLE,* KSI
CYCLES
FORM 120 - BC - 12/64

Fig. 69

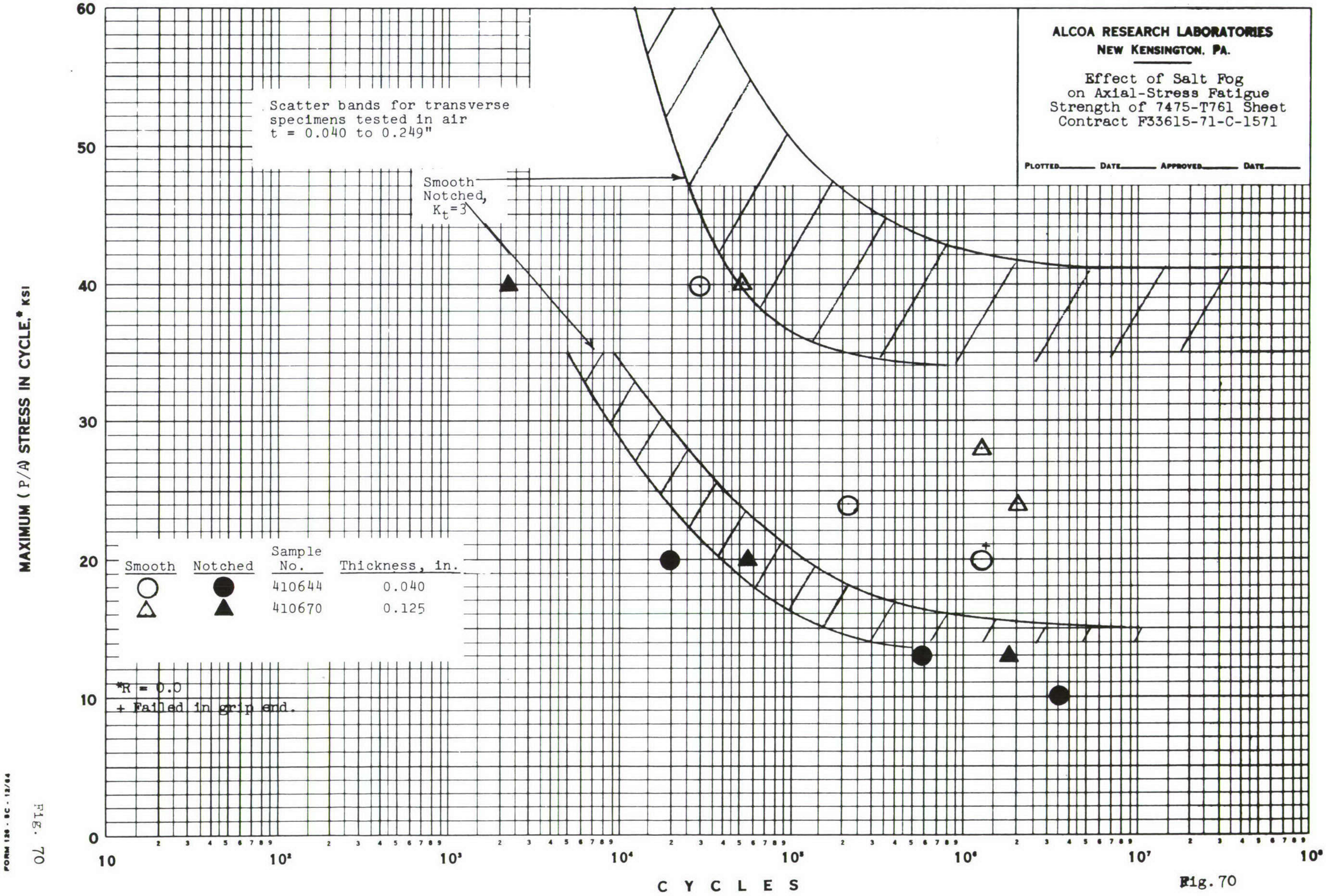

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Effect of Salt Fog on Axial-Stress Fatigue Strength of 7475-T761 Sheet Contract F33615-71-C-1571
PLOTTED DATE APPROVED DATE
Scatter bands for transverse specimens tested in air t = 0.040 to 0.249"
Smooth
Notched, $K_t = 3$
Smooth
Notched
Sample No.
Thickness, in.
410644
0.040
410670
0.125
*R = 0.0
+ Failed in grip end.
MAXIMUM (P/A) STRESS IN CYCLE,* KSI
CYCLES
60
50
40
30
20
10
0
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
FORM 120 - SC - 12/64

Fig. 70

Fig. 70

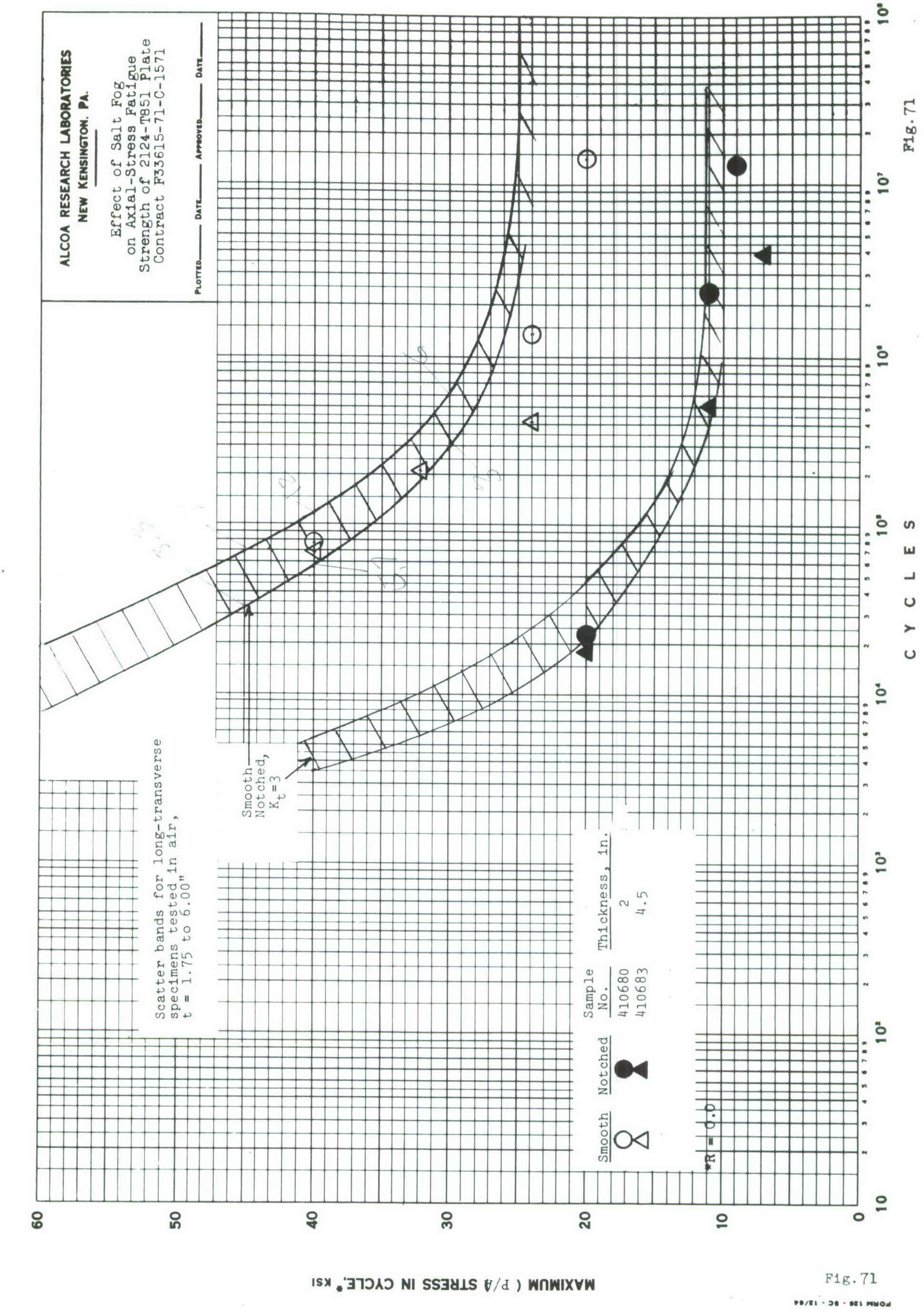
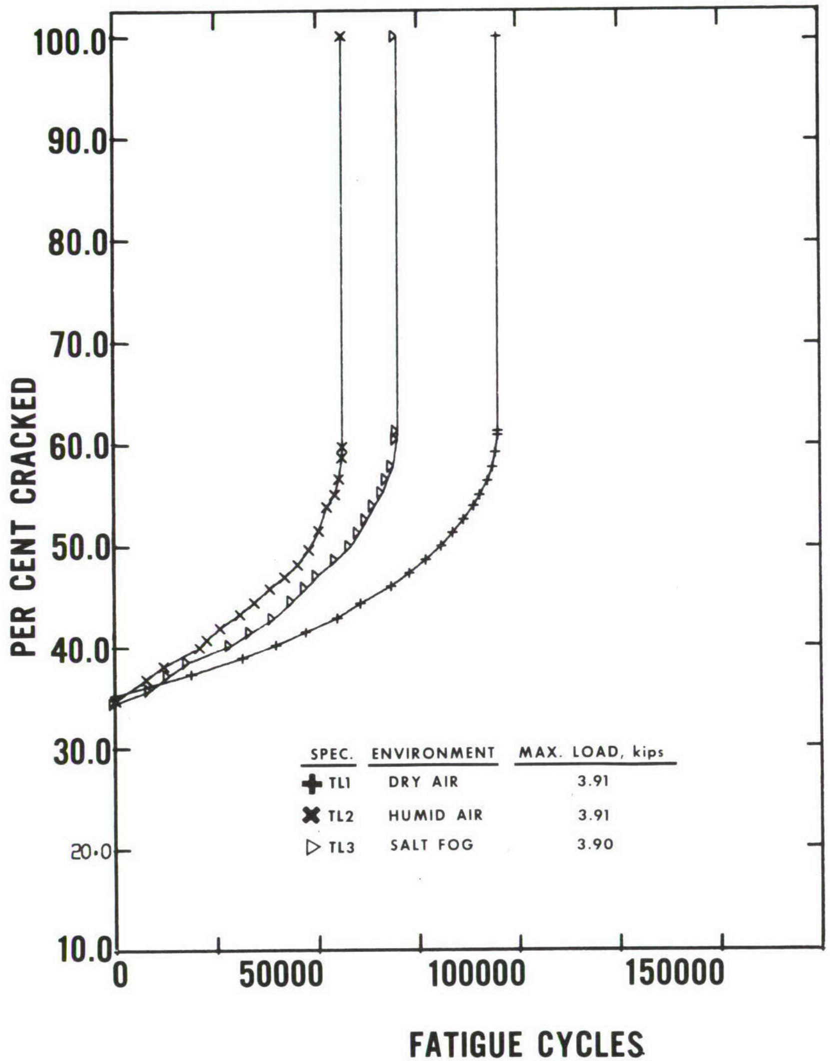
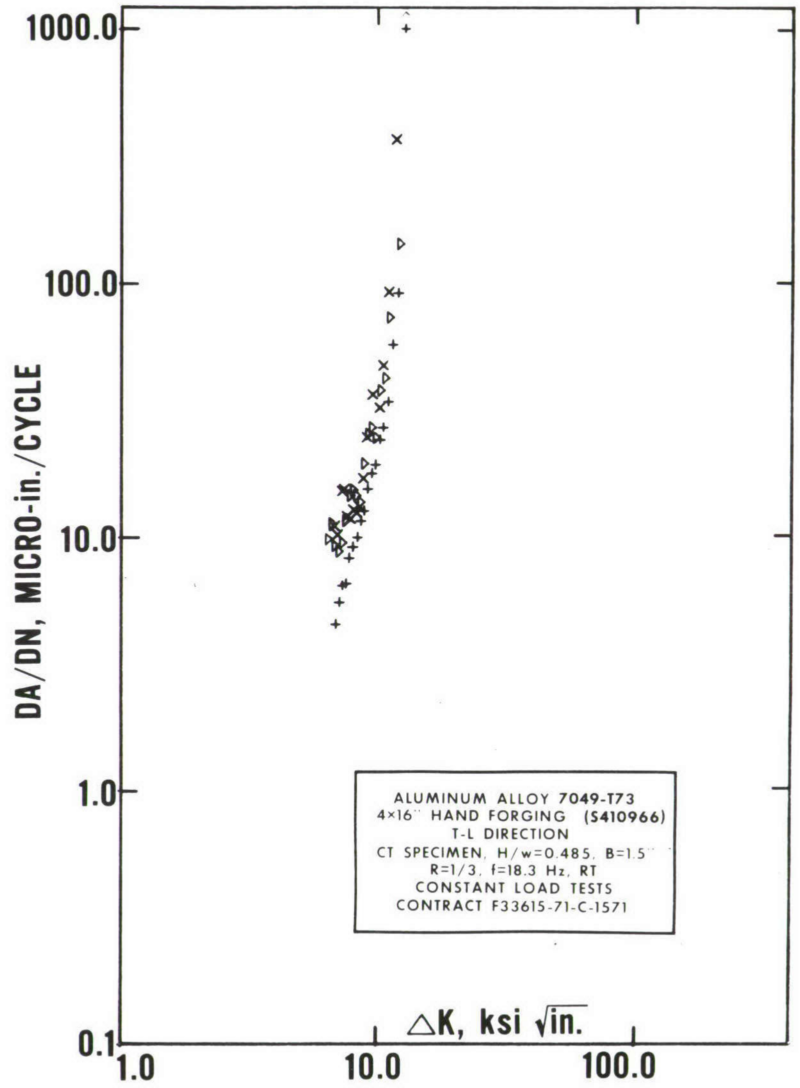

ALCOA RESEARCH LABORATORIES
NEW KENSINGTON, PA.
Effect of Salt Fog on Axial-Stress Fatigue Strength of 2124-T851 Plate
Contract F33615-71-C-1571
PLOTTED ___ DATE ___ APPROVED ___ DATE ___
Scatter bands for long-transverse specimens tested in air, t = 1.75 to 6.00"
Smooth
Notched, $K_t = 3$
Smooth | Notched | Sample No. | Thickness, in.
○ | ● | 410680 | 2
△ | ▲ | 410683 | 4.5
*R = 0.0
MAXIMUM (P/A STRESS IN CYCLE,* KSI
0
10
20
30
40
50
60
CYCLES
10
10^2
10^3
10^4
10^5
10^6
10^7
10^8
Fig. 71
FORM 126 - 5C - 12/64

Fig. 71

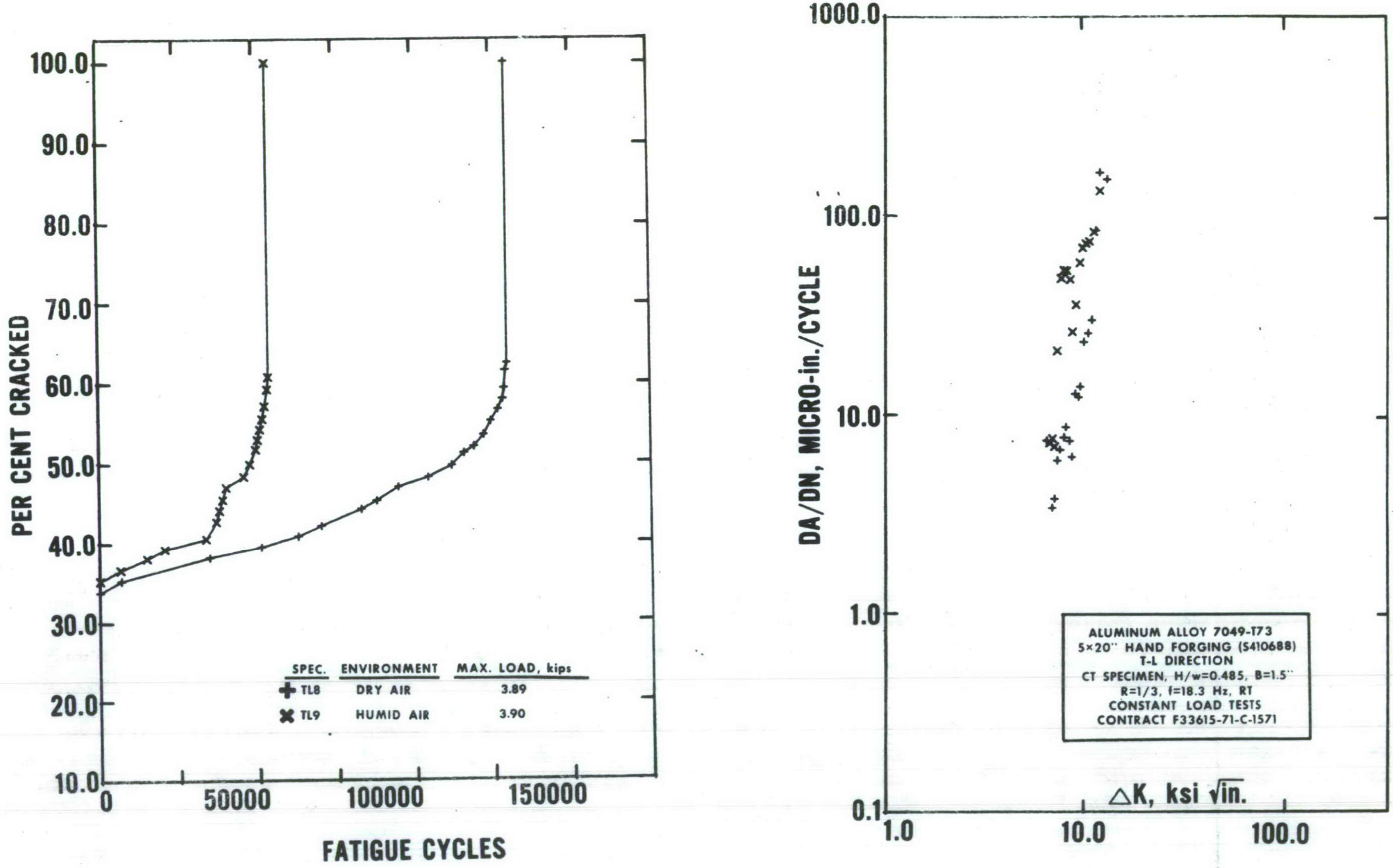




FATIGUE CRACK GROWTH DATA FOR 4 X 16-in. 7049-T73 HAND FORGING, T-L ORIENTATION, [CT SPECIMENS]

Fig. 72

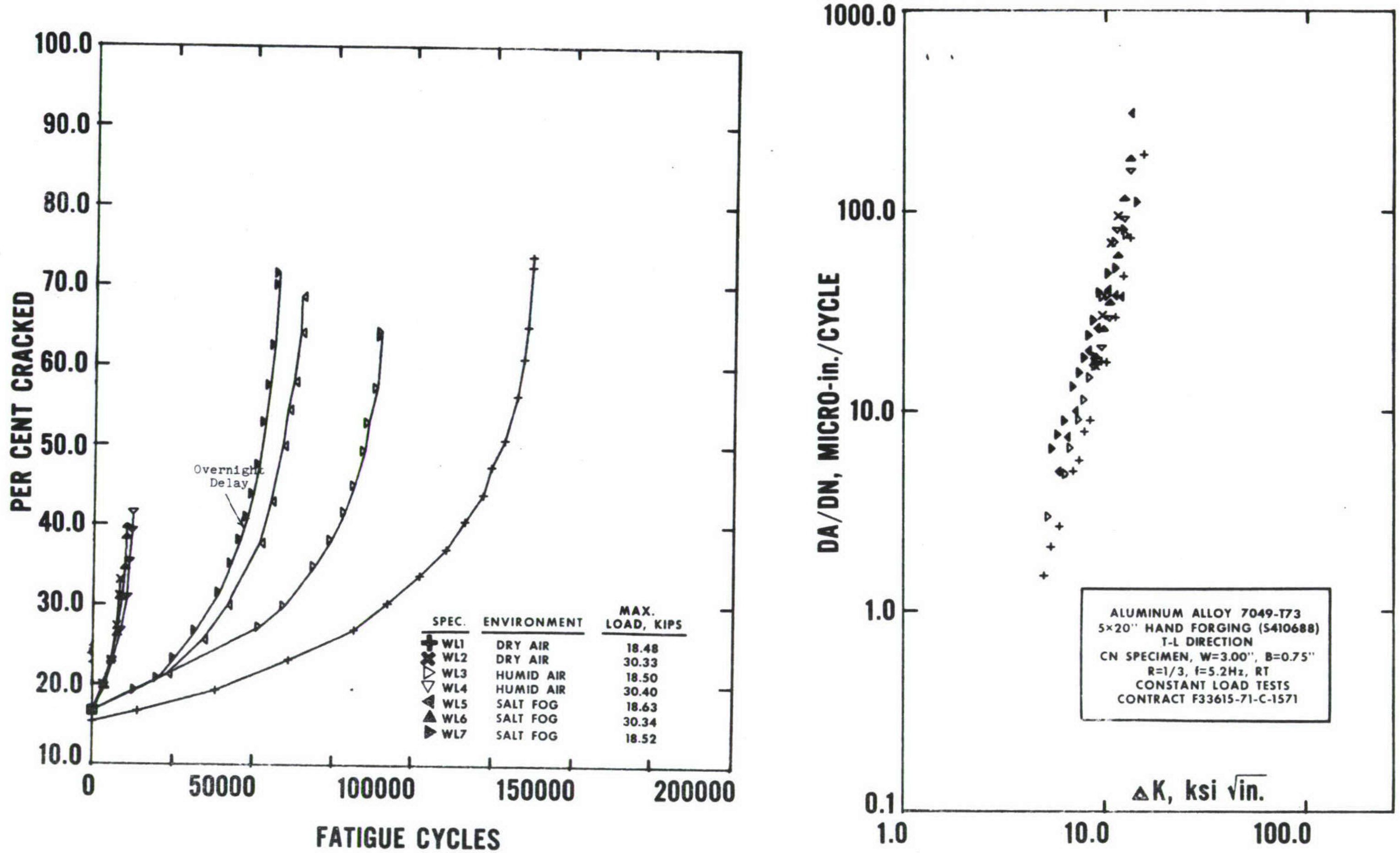
Fig. 72



FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7049-T73 HAND FORGING, T-L ORIENTATION, [CT SPECIMENS]

Fig. 73

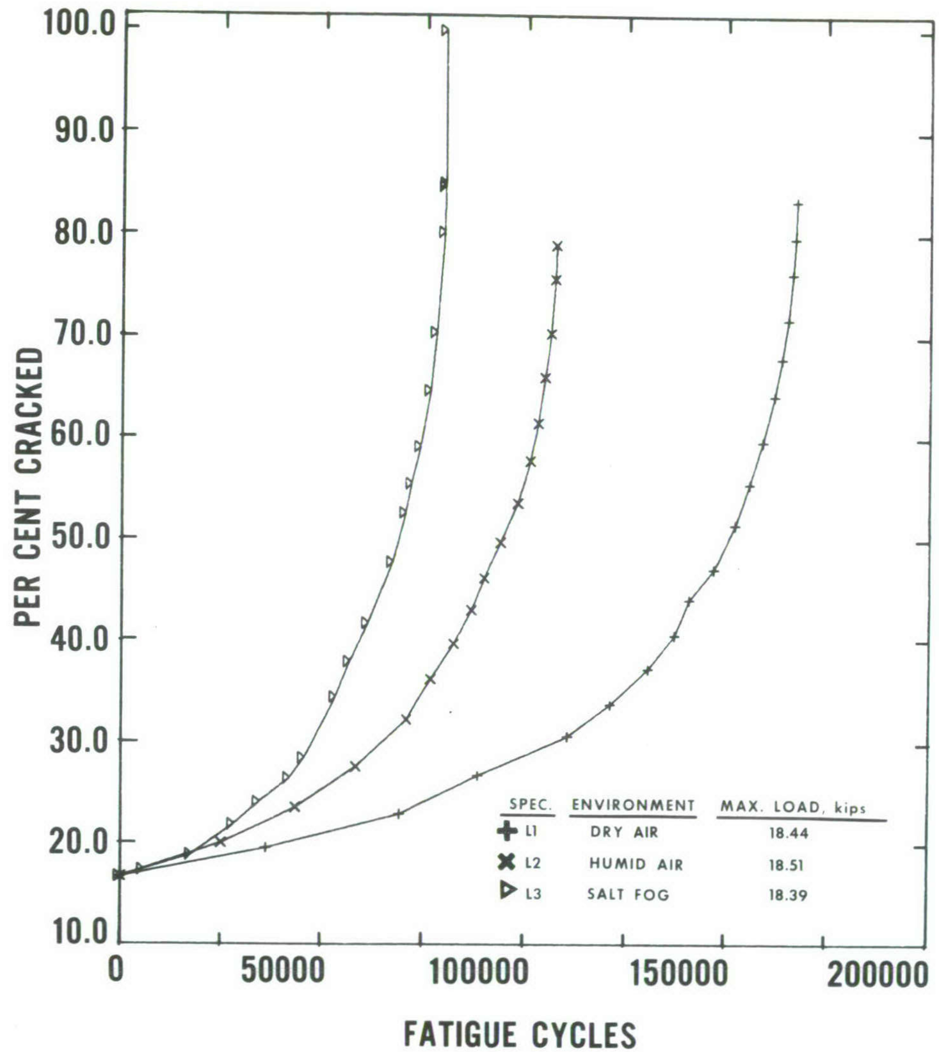
Fig. 73

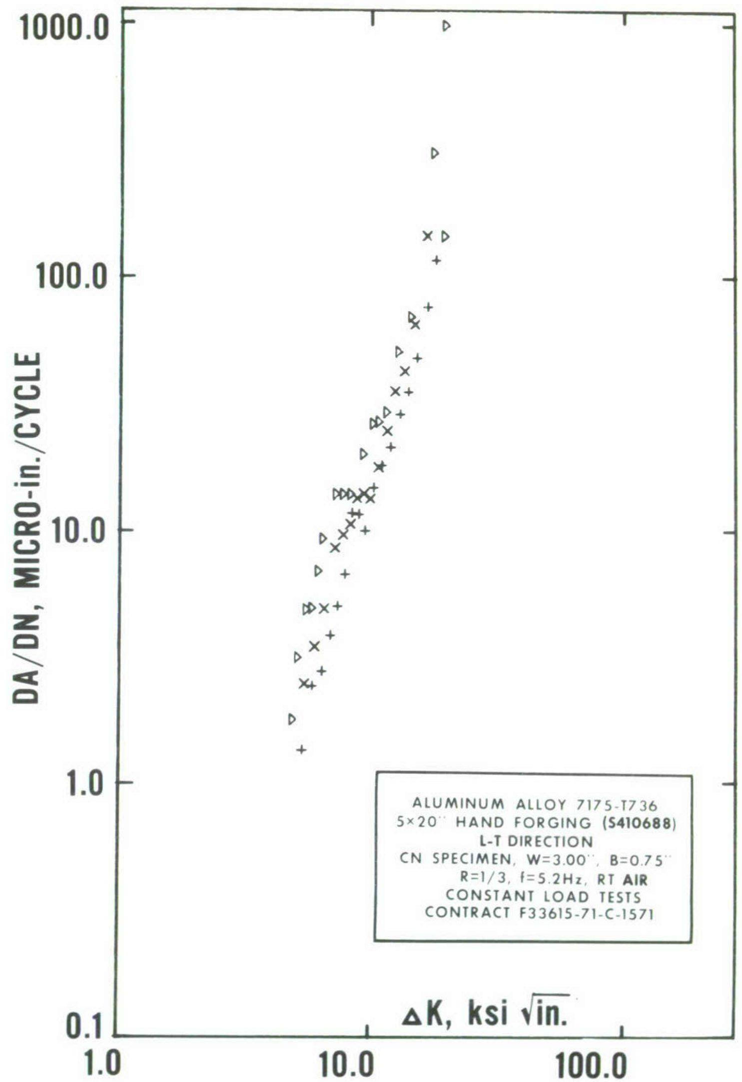


FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7049-T73 HAND FORGING, T-L ORIENTATION, [CN SPECIMENS]

Fig. 74

Fig. 74

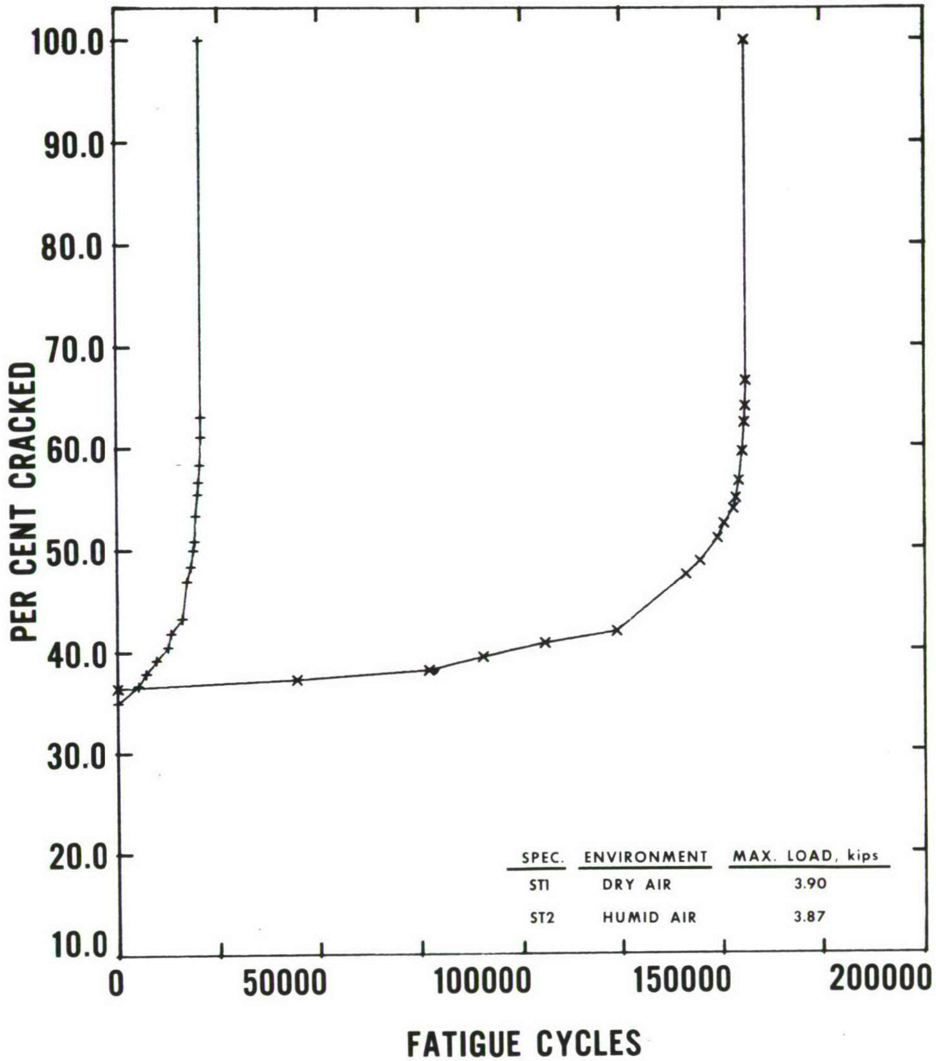


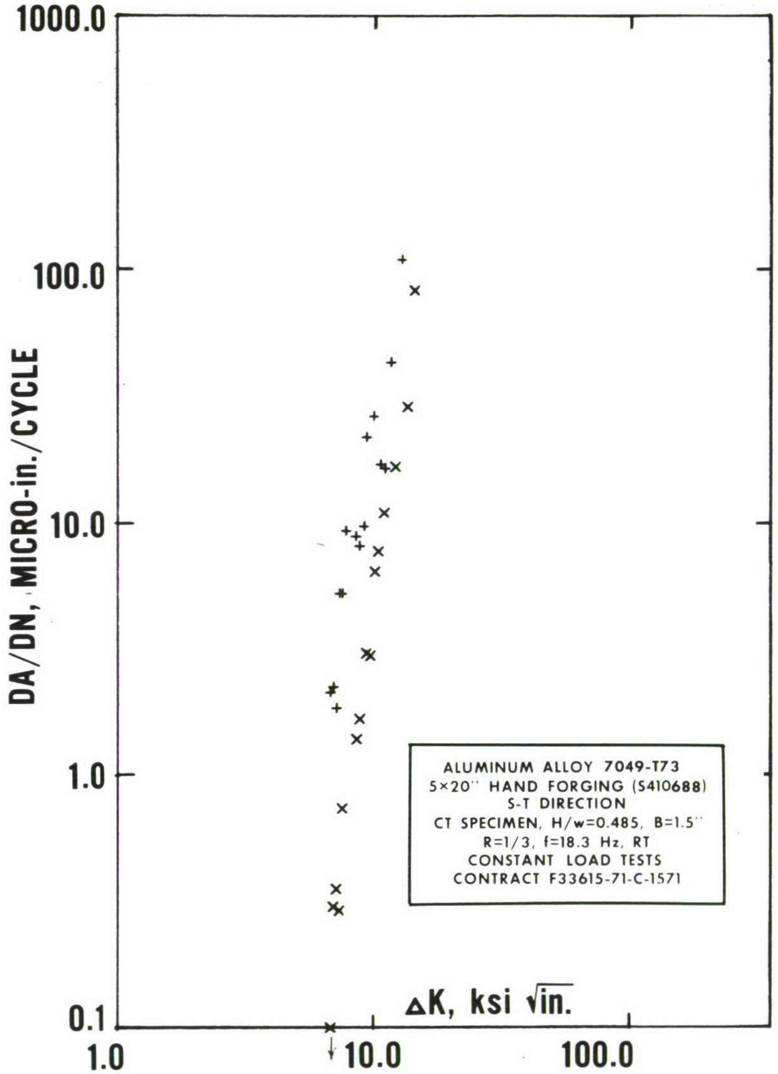


FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7049-T73 HAND FORGING, L-T ORIENTATION, [CN SPECIMENS]

Fig. 75

Fig. 75

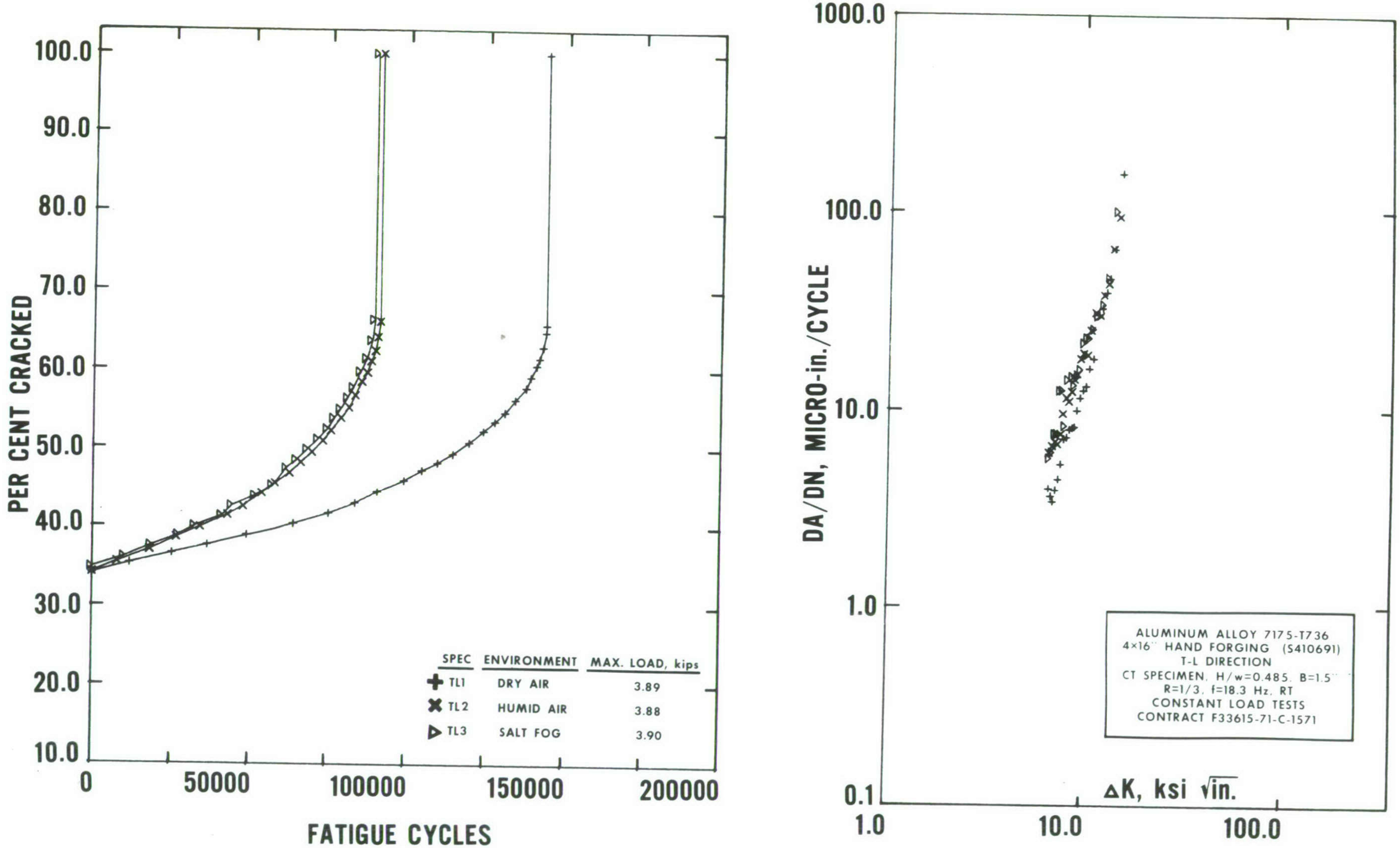




FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7049-T73 HAND FORGING, S-T ORIENTATION, [CT SPECIMENS]

Fig. 76

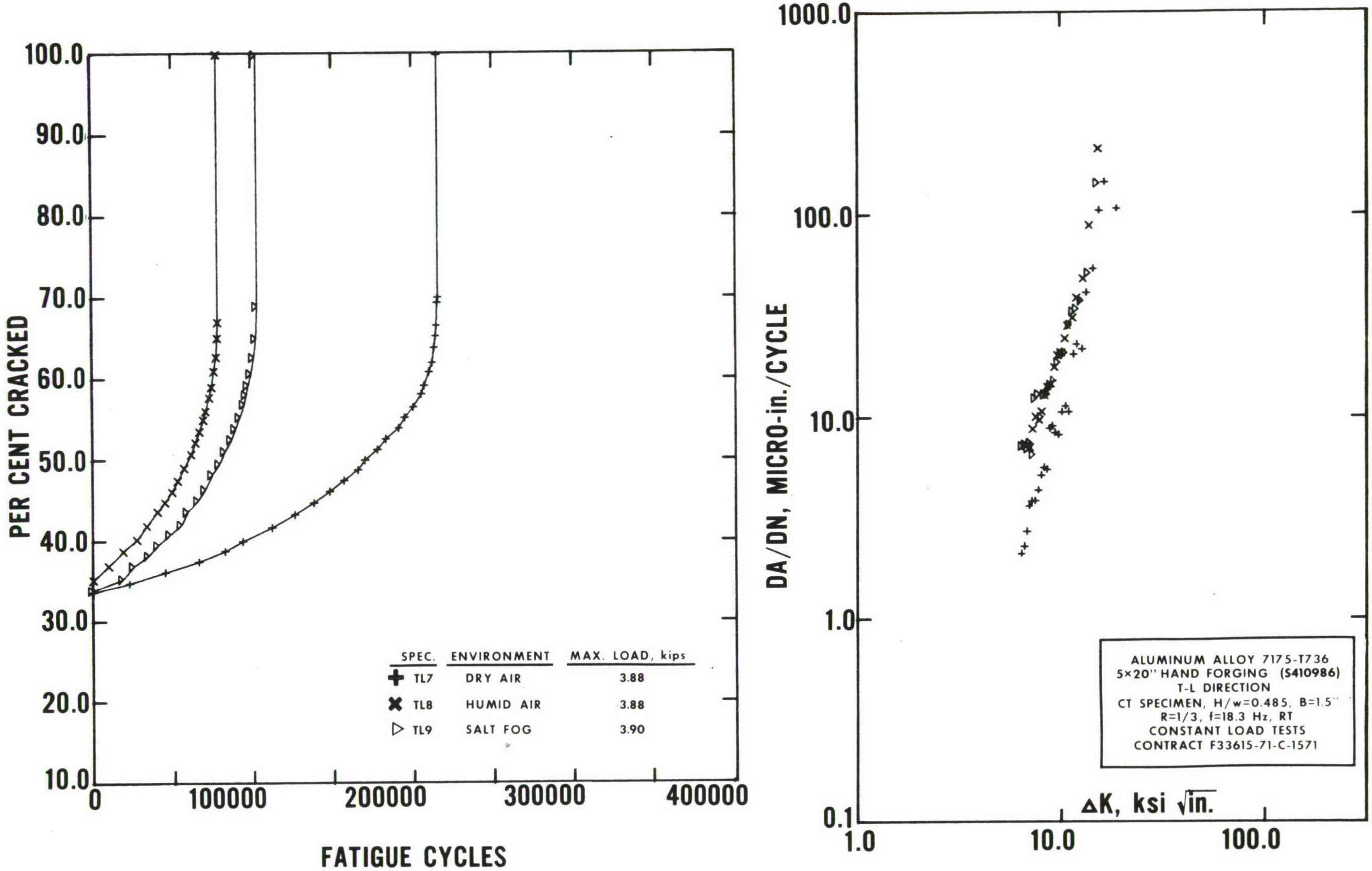
Fig. 76



FATIGUE CRACK GROWTH DATA FOR 4 X 16-in. 7175-T736 HAND FORGING, T-L ORIENTATION, [CT SPECIMENS]

Fig. 77

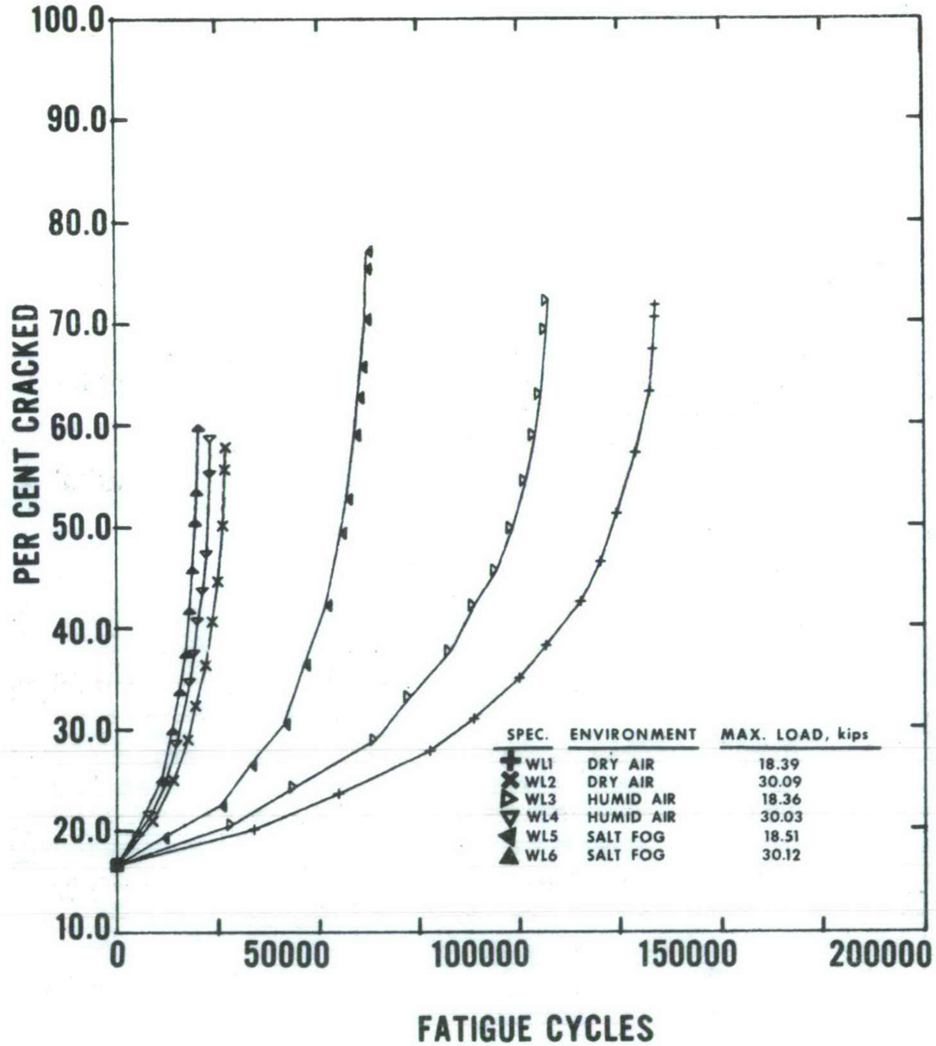
Fig. 77

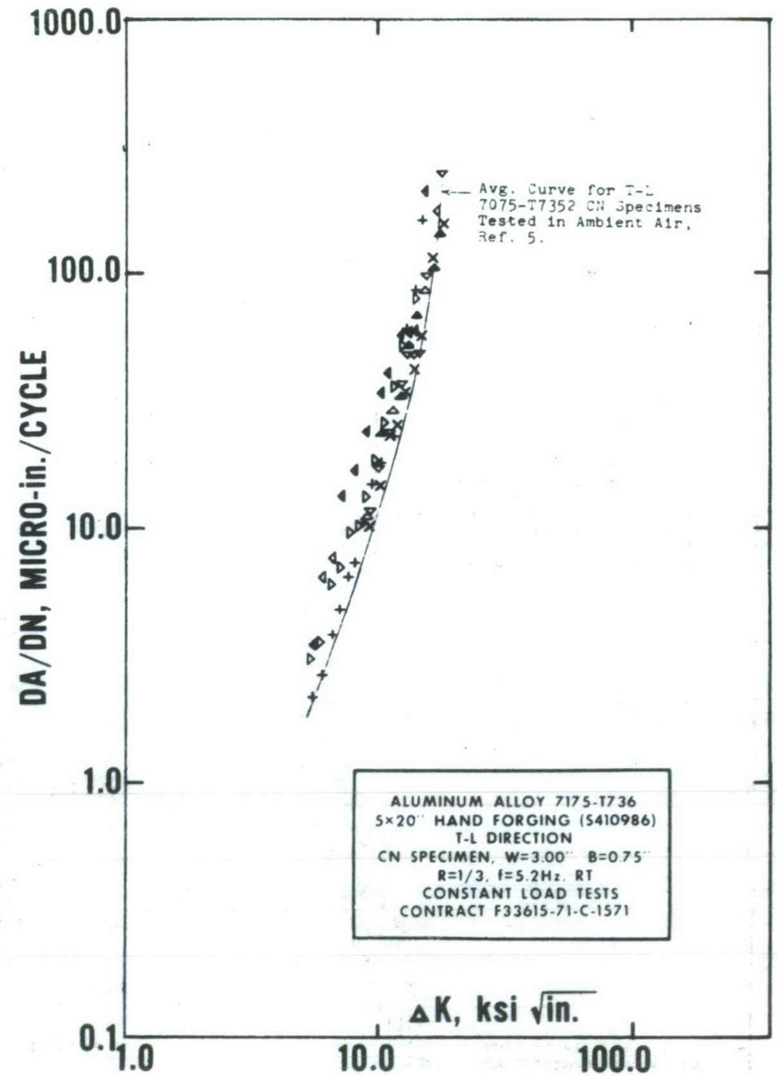


FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7175-T736 HAND FORGING, T-L ORIENTATION, [CT SPECIMENS]

Fig. 78

Fig. 78

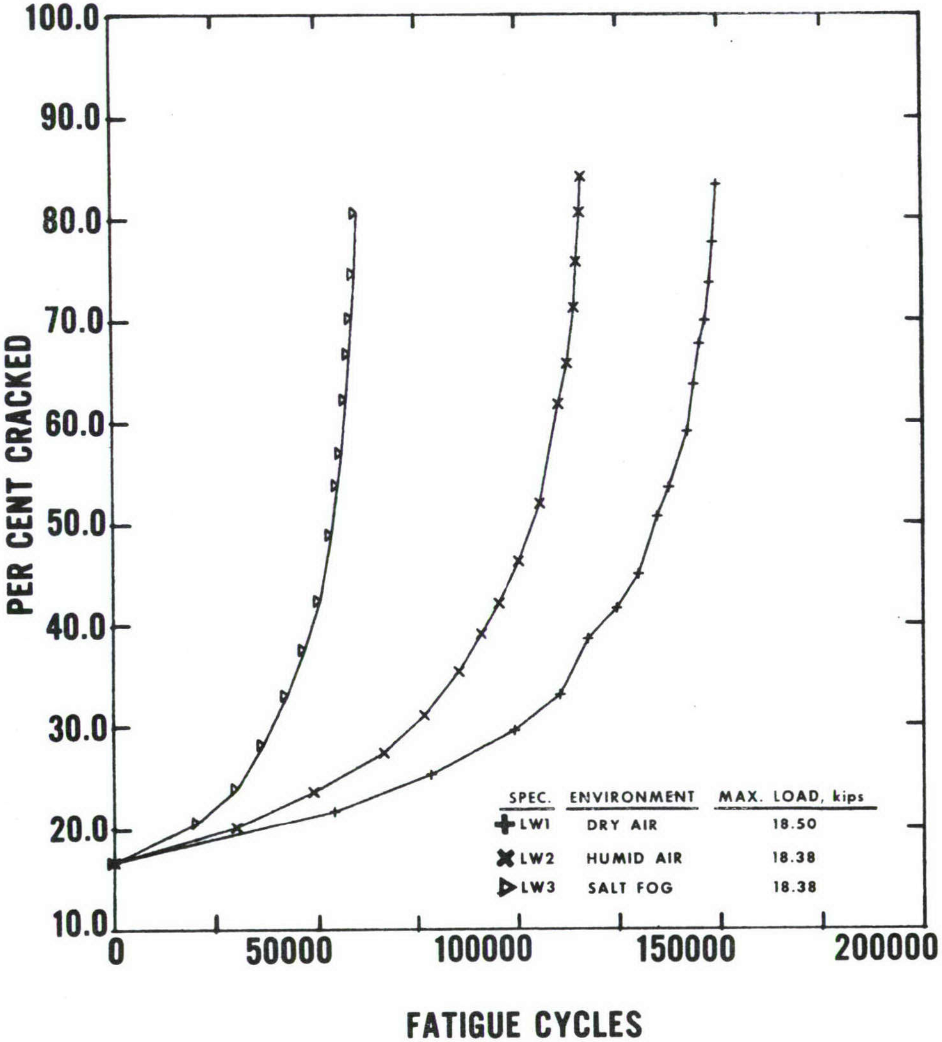


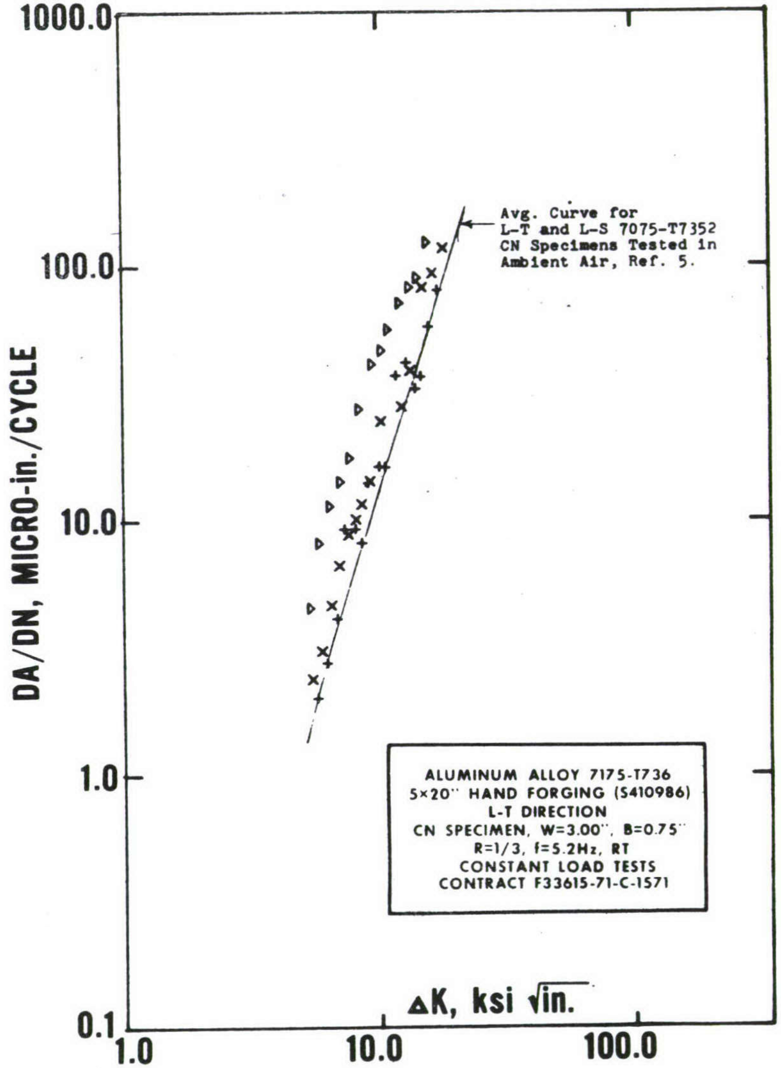


FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7175-T736 HAND FORGING, T-L ORIENTATION, [CN SPECIMENS]

Fig. 79 (12)

Fig. 79

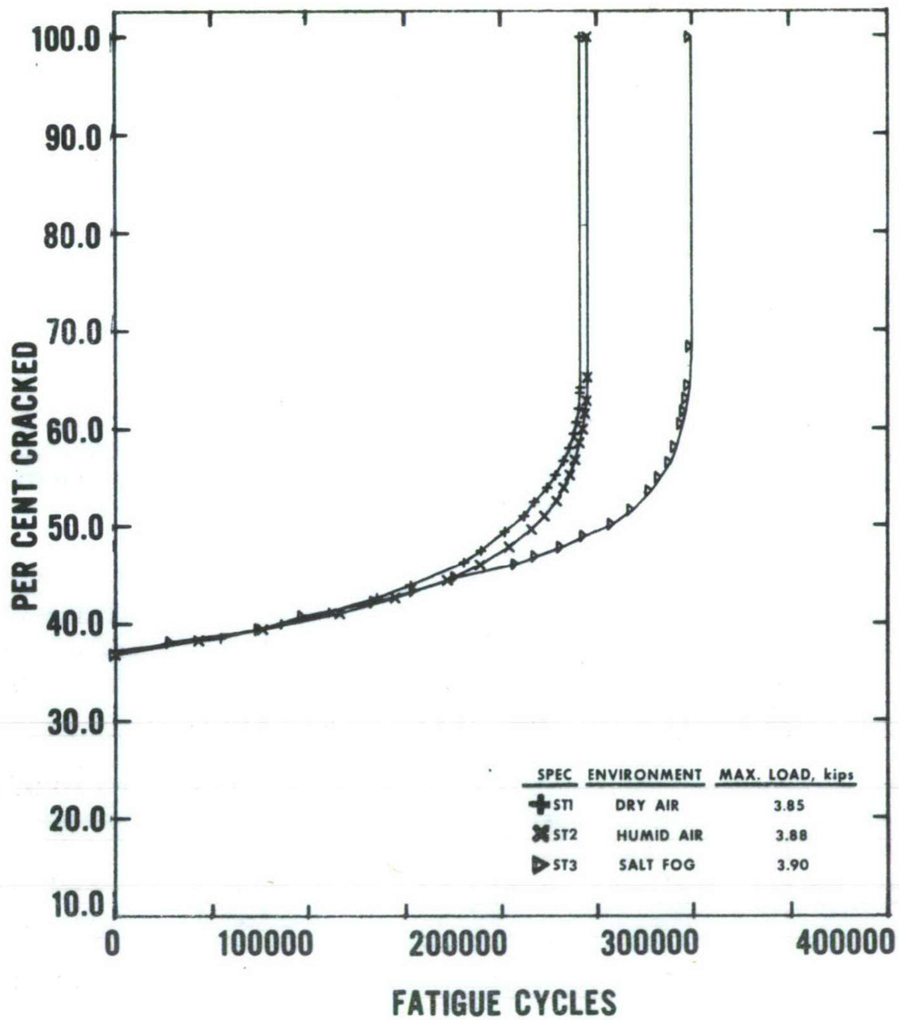


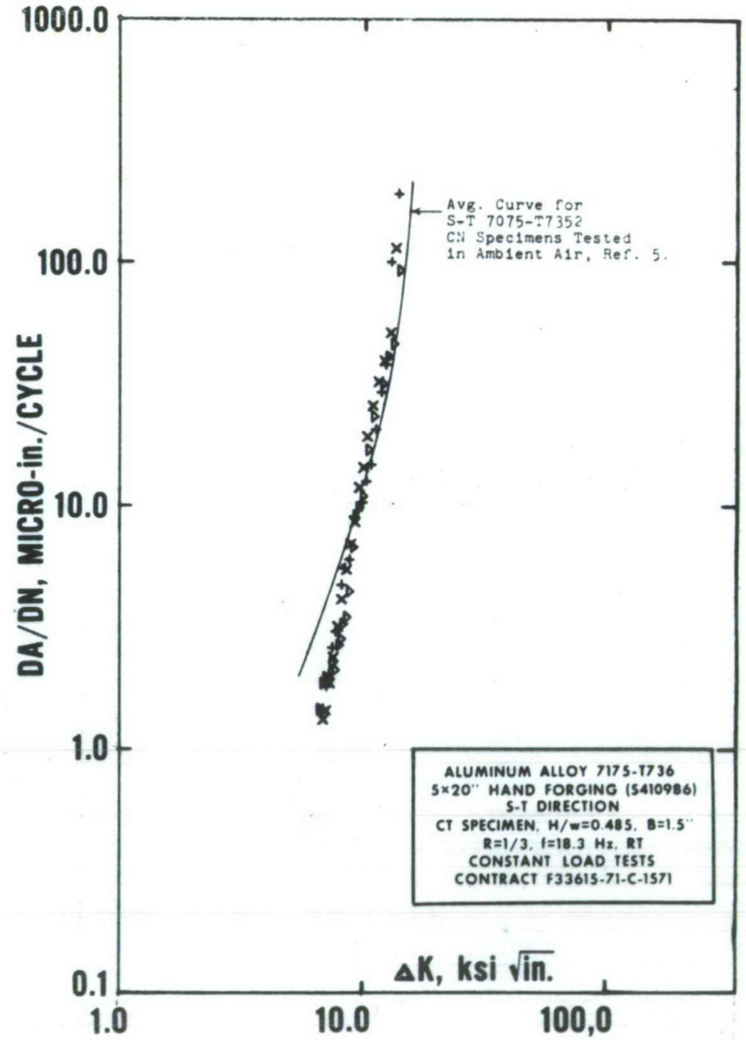


FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7175-T736 HAND FORGING, L-T ORIENTATION, [CN SPECIMENS]

Fig. 80

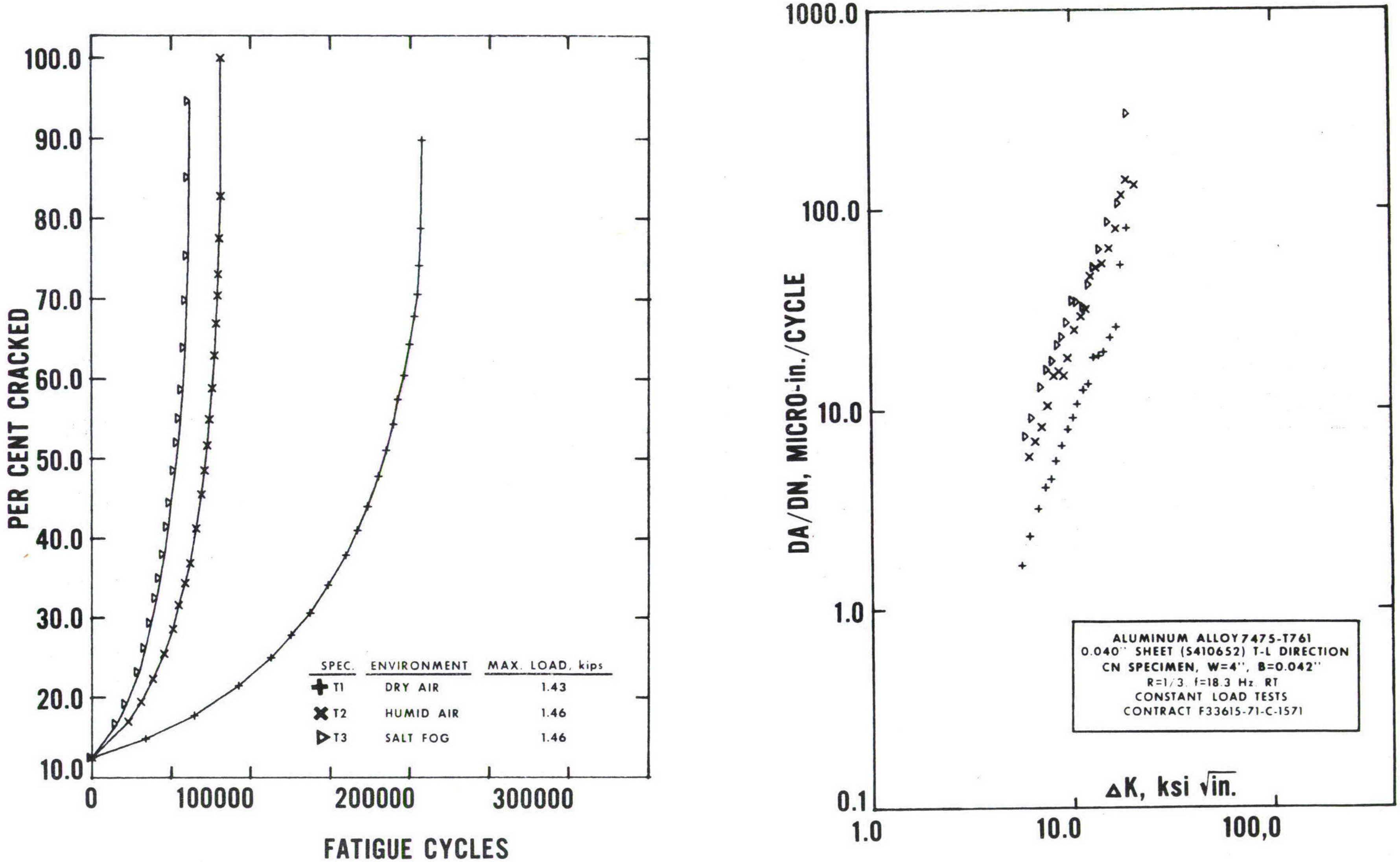
Fig. 80





FATIGUE CRACK GROWTH DATA FOR 5 X 20-in. 7175-T736 HAND FORGING, S-T ORIENTATION, [CT SPECIMENS]

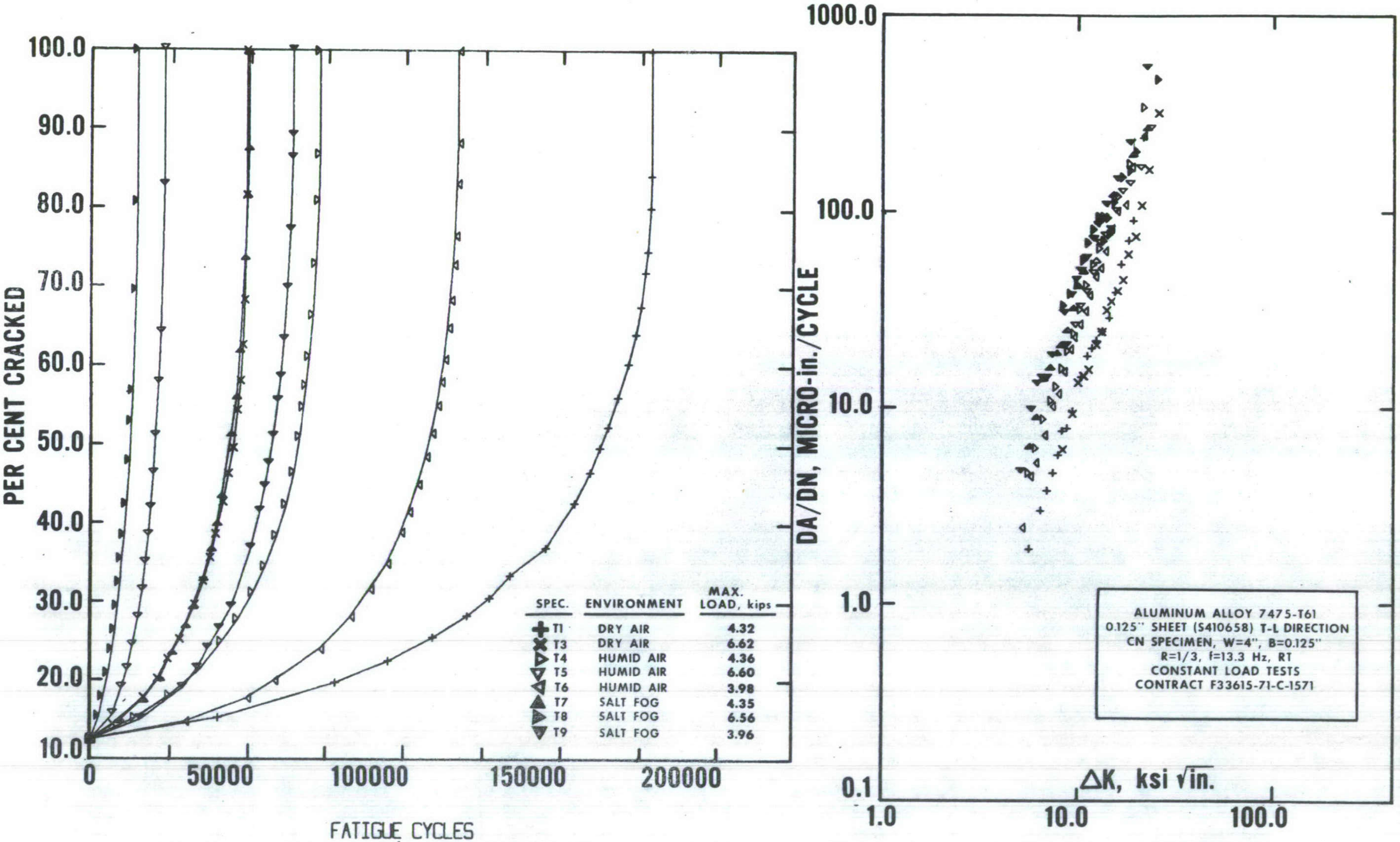
Fig. 81



FATIGUE CRACK GROWTH DATA FOR 0.040-in. 7475-T61 SHEET, T-L ORIENTATION, [CN SPECIMENS]

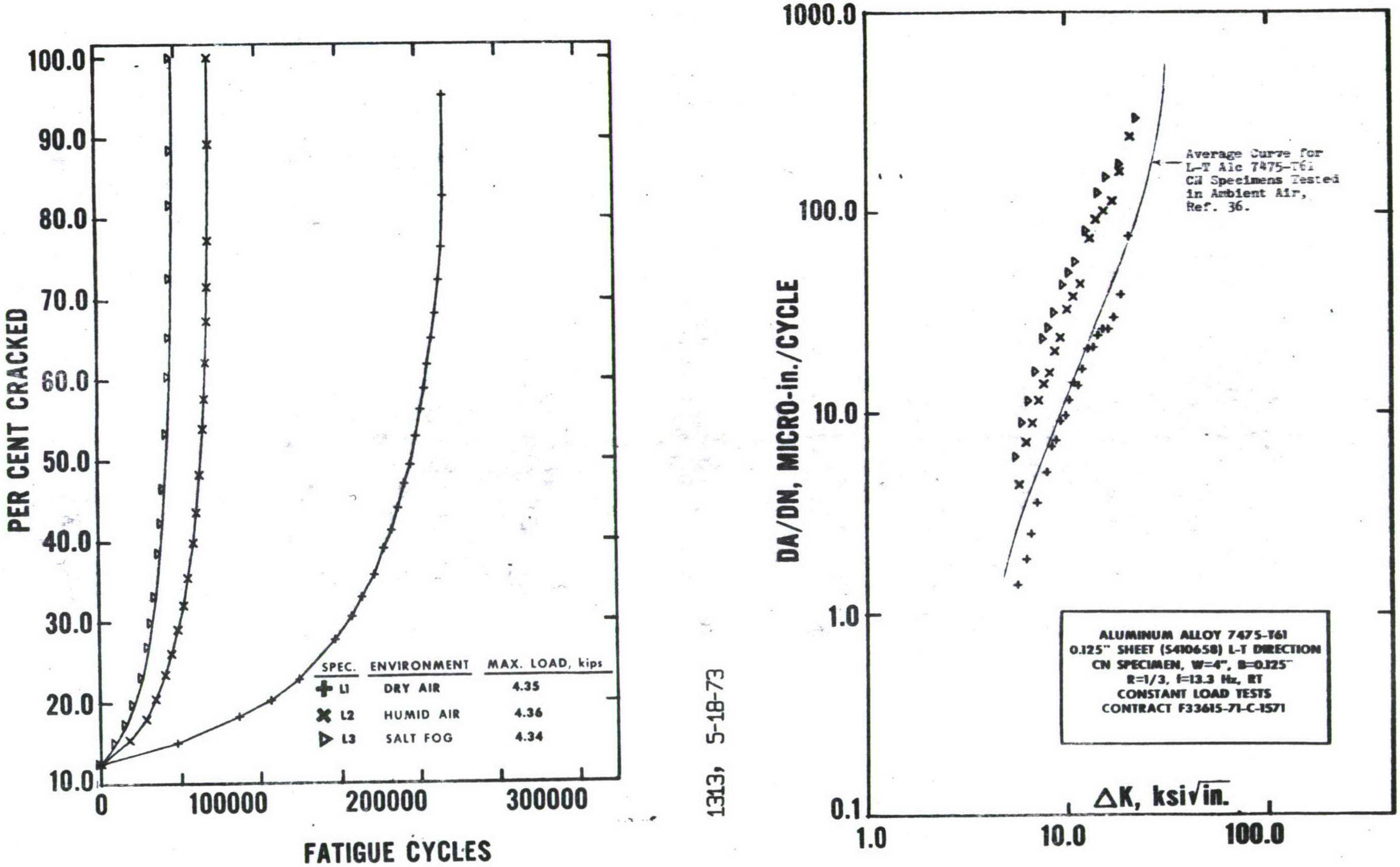
Fig. 82

Fig. 82



FATIGUE CRACK GROWTH DATA FOR 0.125-in. 7475-T61 SHEET, T-L ORIENTATION, [CN SPECIMENS]

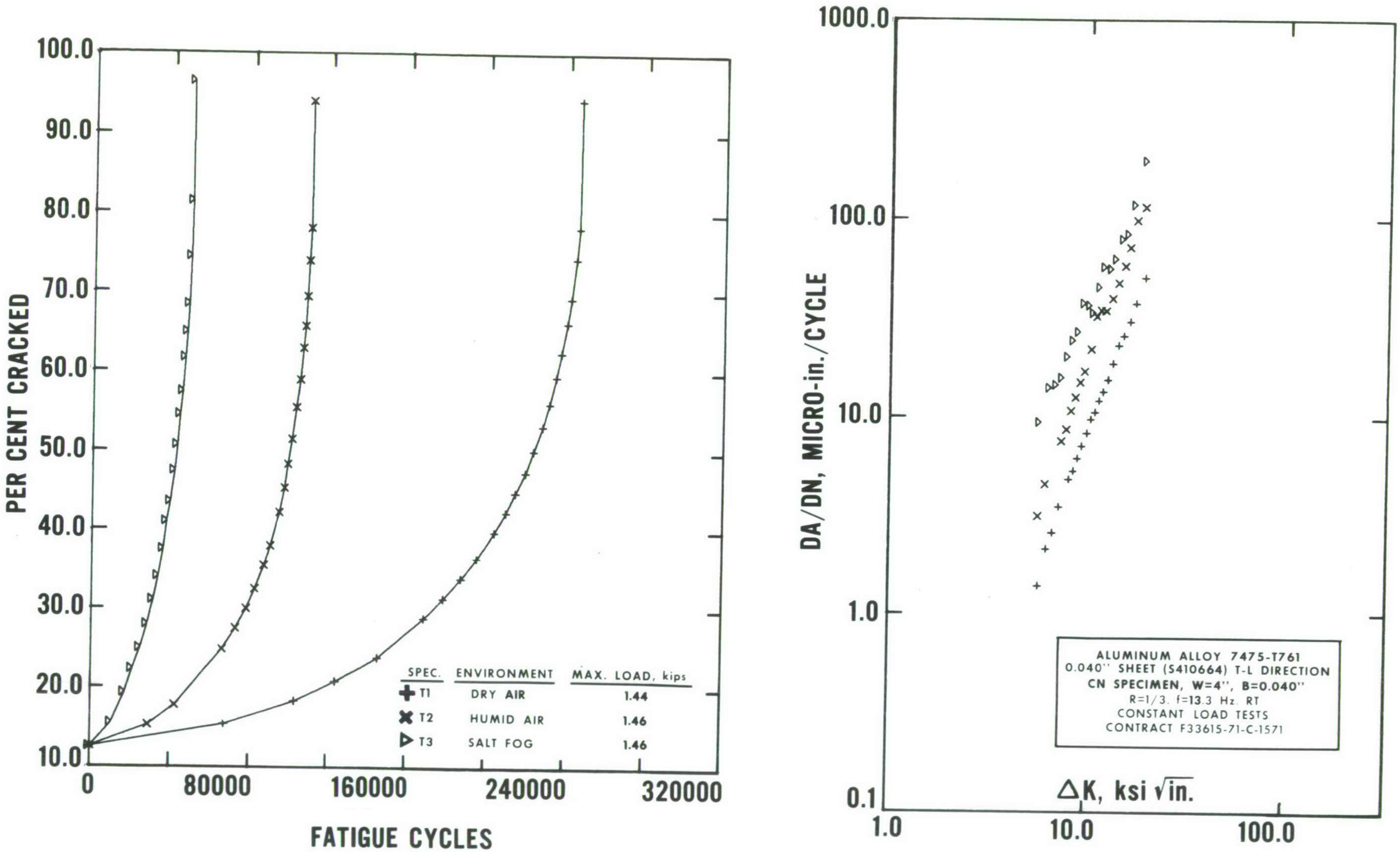
Fig. 83



FATIGUE CRACK GROWTH DATA FOR 0.125-in. 7475-T61 SHEET, L-T ORIENTATION, [CN SPECIMENS]

Fig. 84

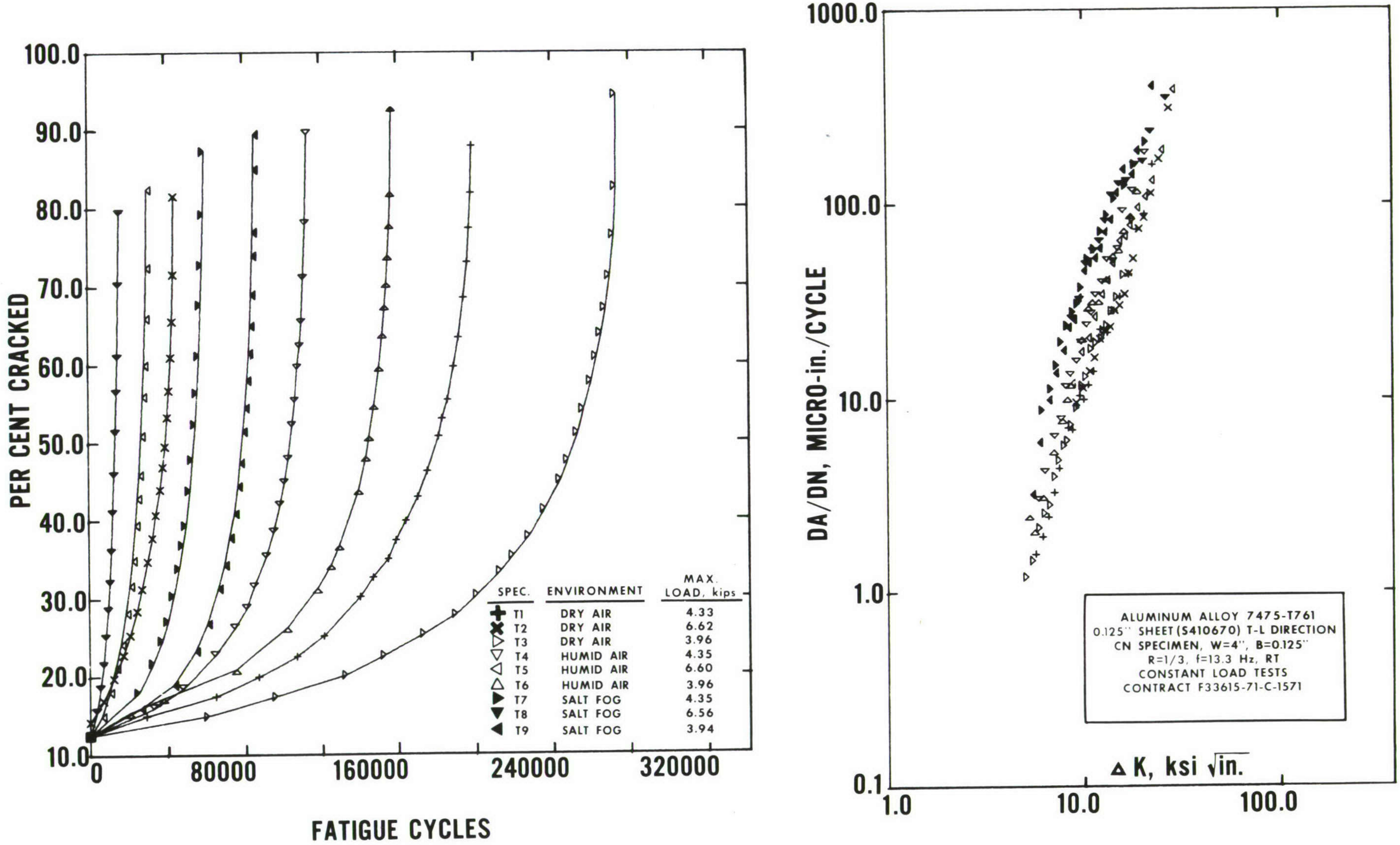
Fig. 84



FATIGUE CRACK GROWTH DATA FOR 0.040-in. 7475-T761 SHEET, T-L ORIENTATION, [CN SPECIMENS]

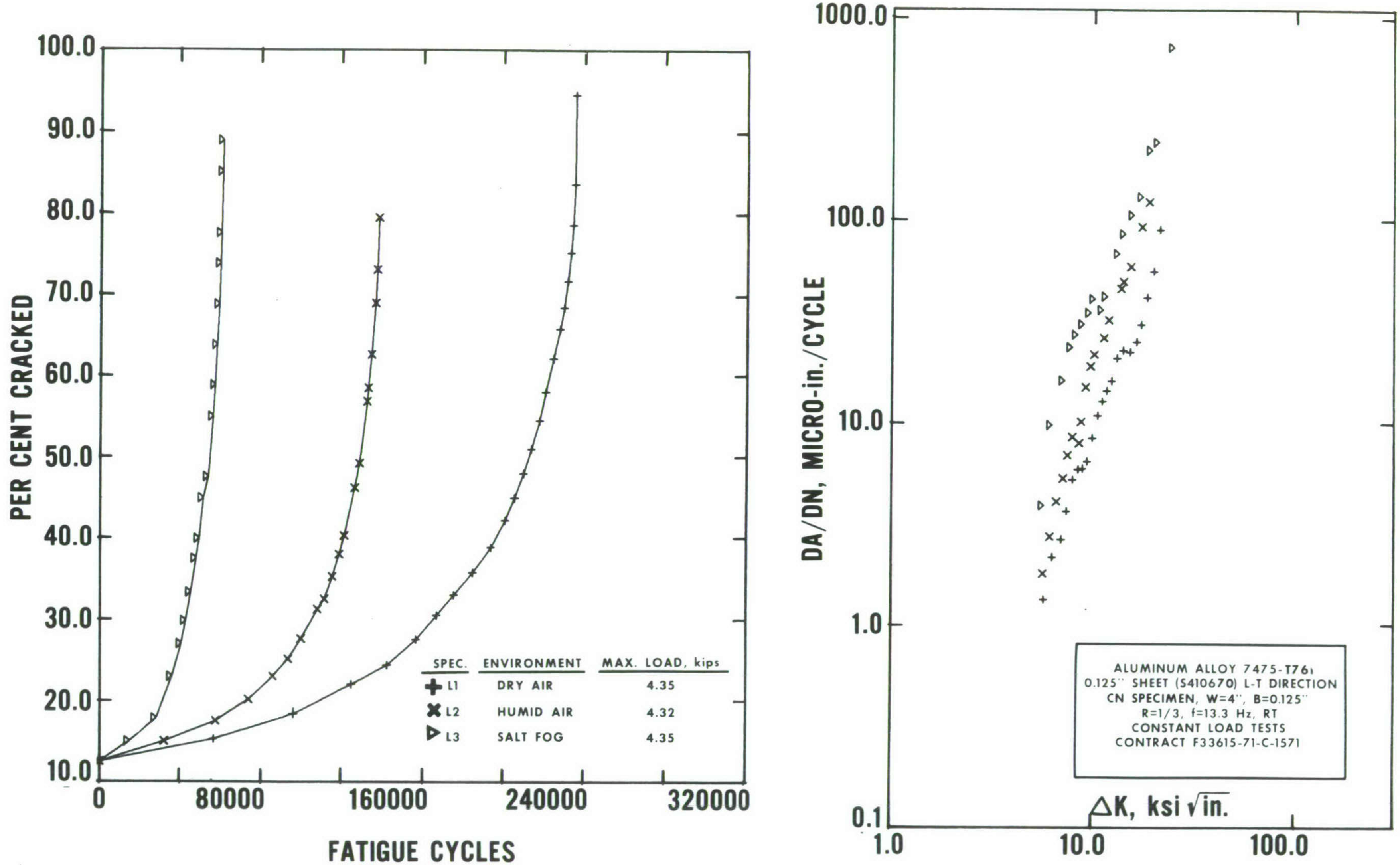
Fig. 85

Fig. 85



FATIGUE CRACK GROWTH DATA FOR 0.125-in. 7475-T761 SHEET, T-L ORIENTATION, [CN SPECIMENS]

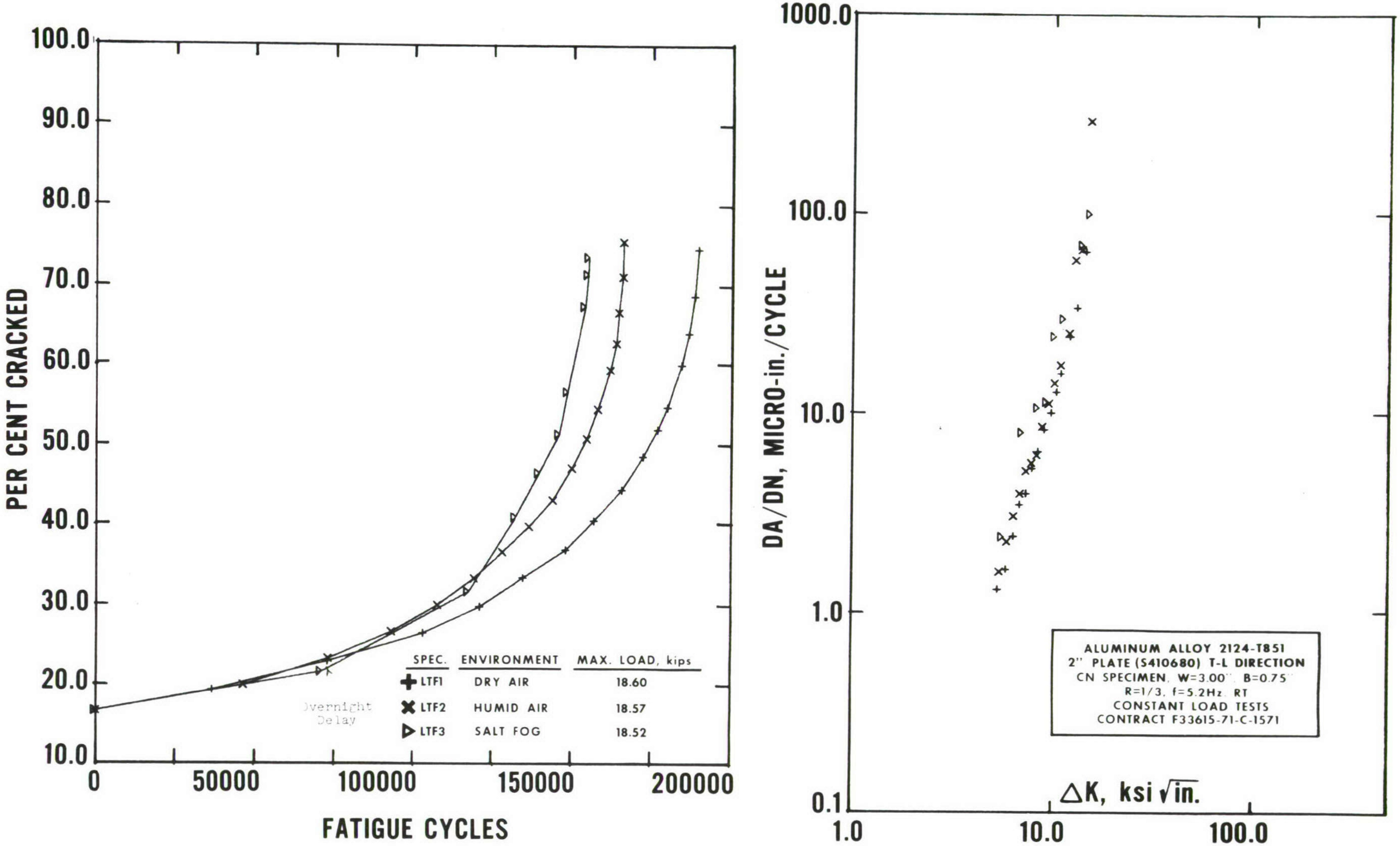
Fig. 86



FATIGUE CRACK GROWTH DATA FOR 0.125-in. 7475-T761 SHEET, L-T ORIENTATION, [CN SPECIMENS]

Fig. 87

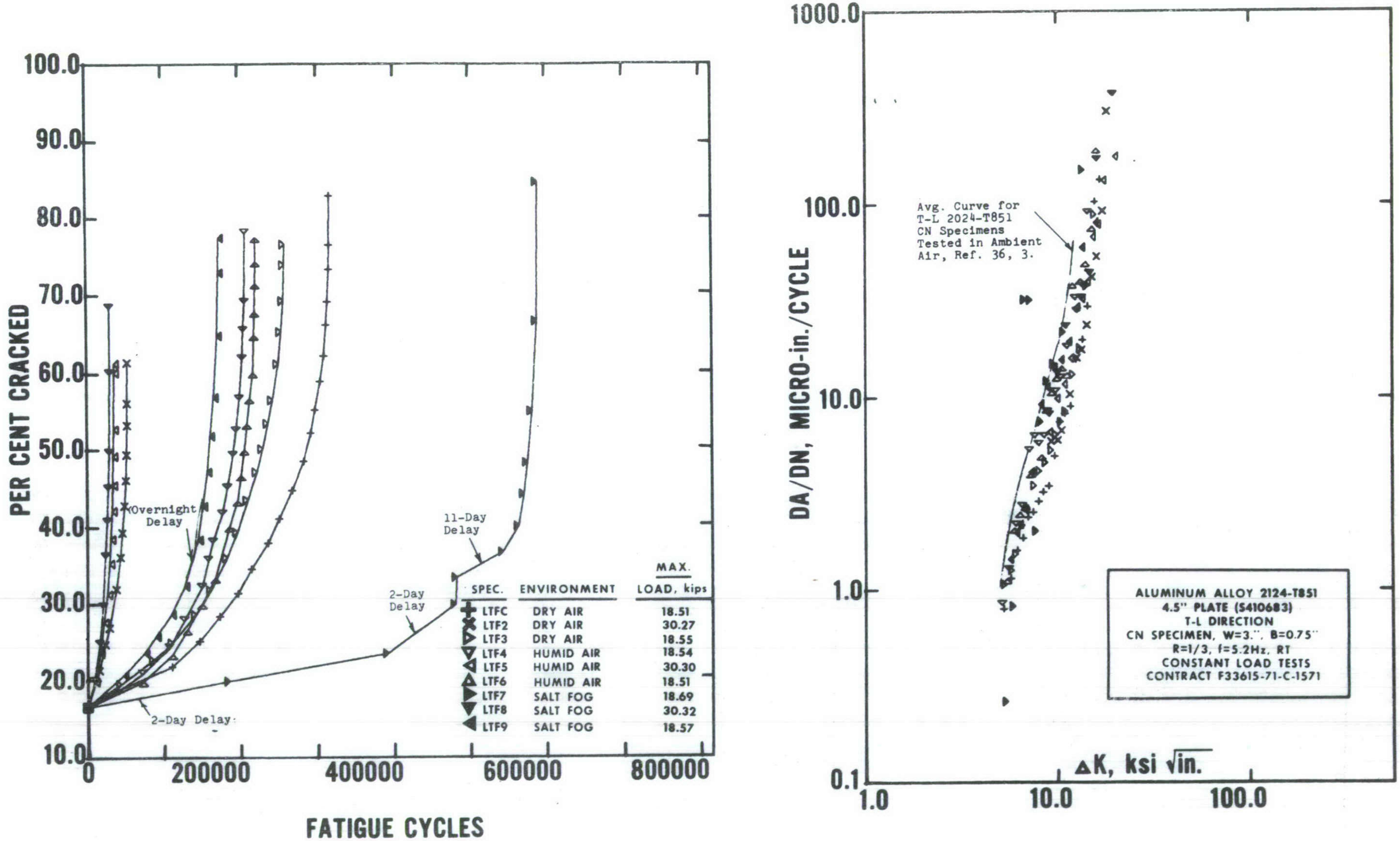
Fig. 87



FATIGUE CRACK GROWTH DATA FOR 2-in. 2124-T851 PLATE, T-L ORIENTATION, [CN SPECIMENS]

Fig. 88

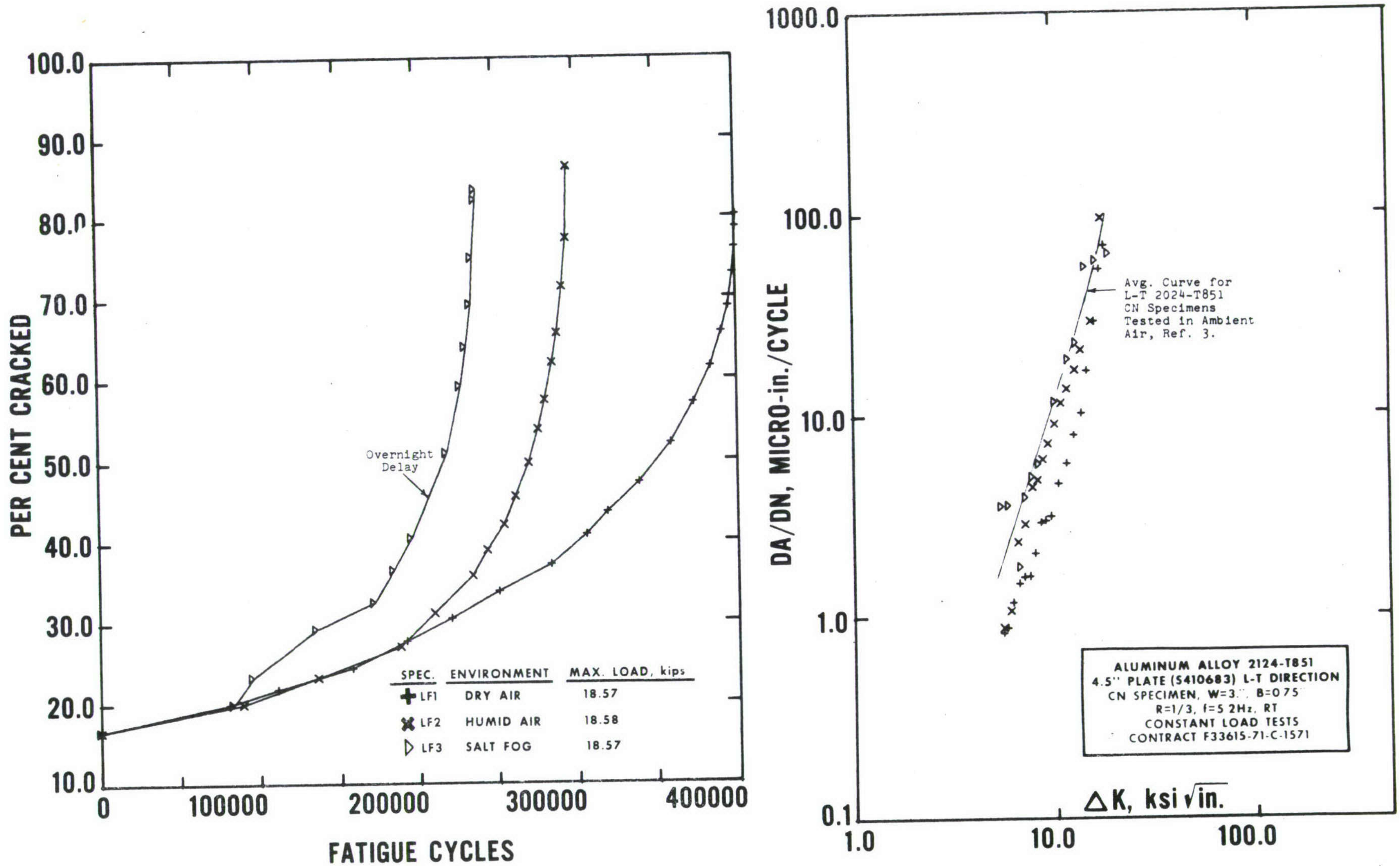
Fig. 88



FATIGUE CRACK GROWTH DATA FOR 4.5-in. 2124-T851 PLATE, T-L ORIENTATION, [CN SPECIMENS]

Fig. 89

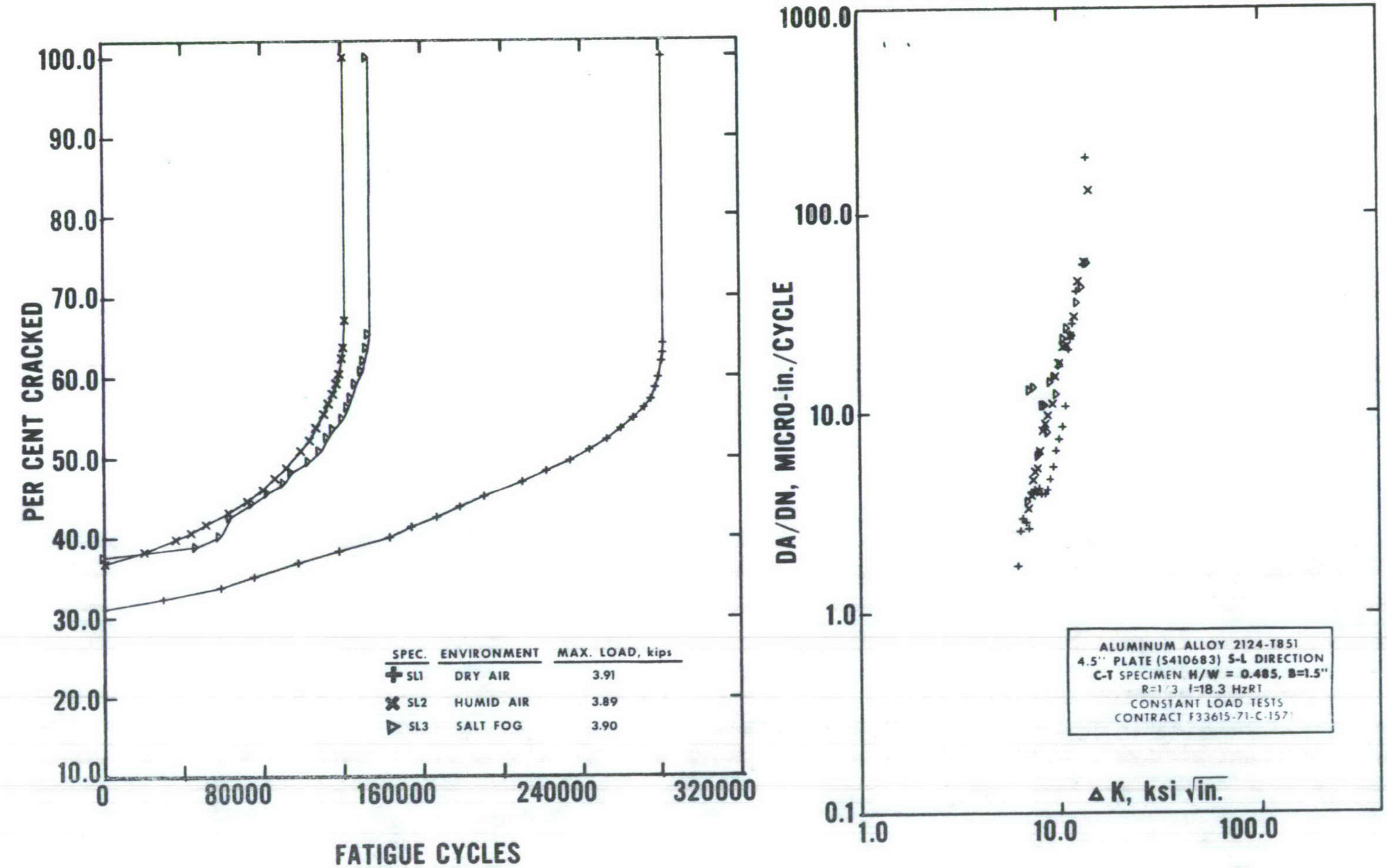
Fig. 89



FATIGUE CRACK GROWTH DATA FOR 4.5-in. 2124-T851 PLATE, L-T ORIENTATION, [CN SPECIMENS]

Fig. 90

Fig. 90



FATIGUE CRACK GROWTH DATA FOR 4.5-in. 2124-T851 PLATE, S-L ORIENTATION, [CT SPECIMENS]

Fig. 91

Fig. 91

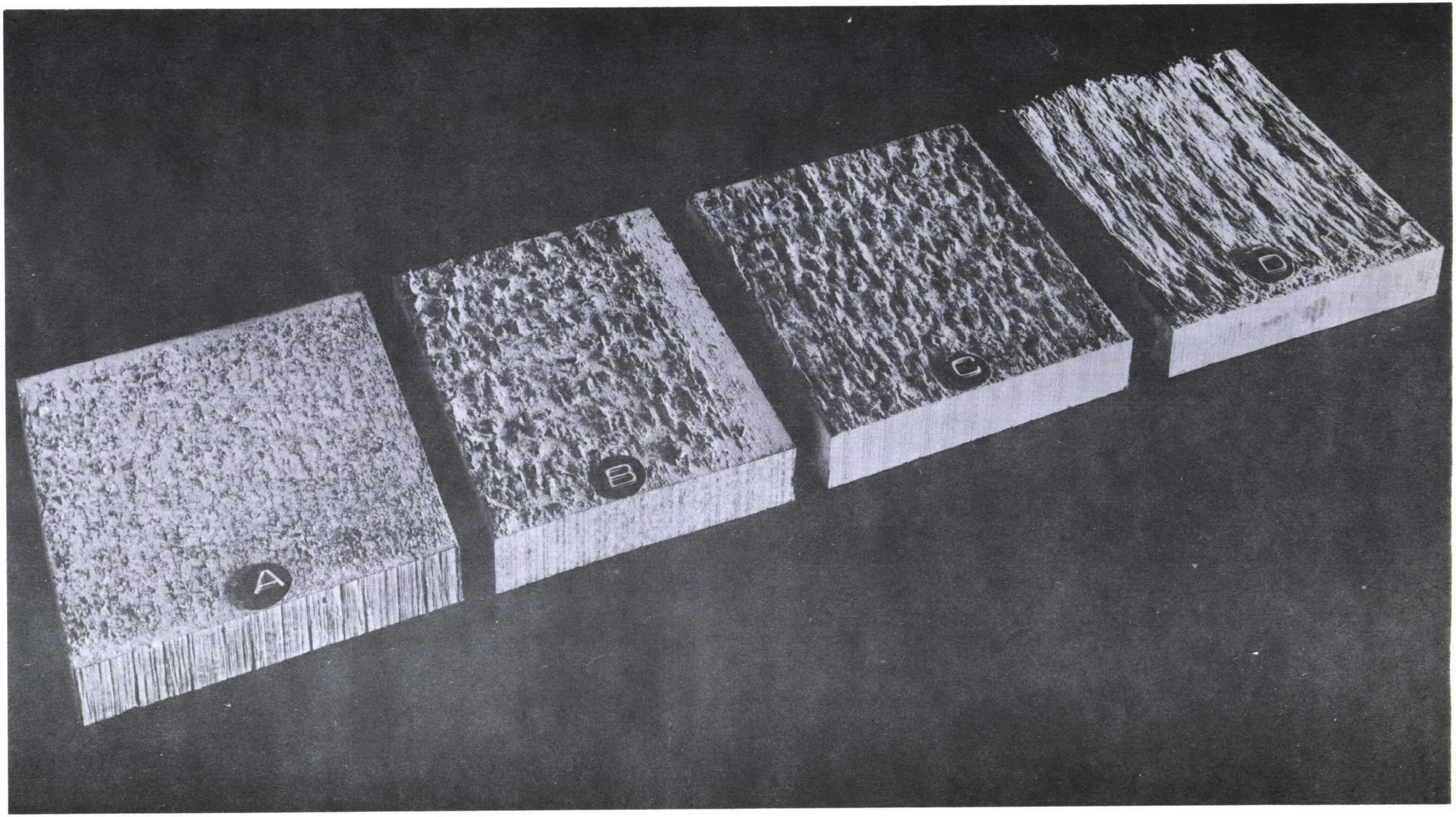


Fig. 92 Typical Example of the Four Degrees of Exfoliation Indicated By Code Letters E-A, E-B, E-C and E-D.

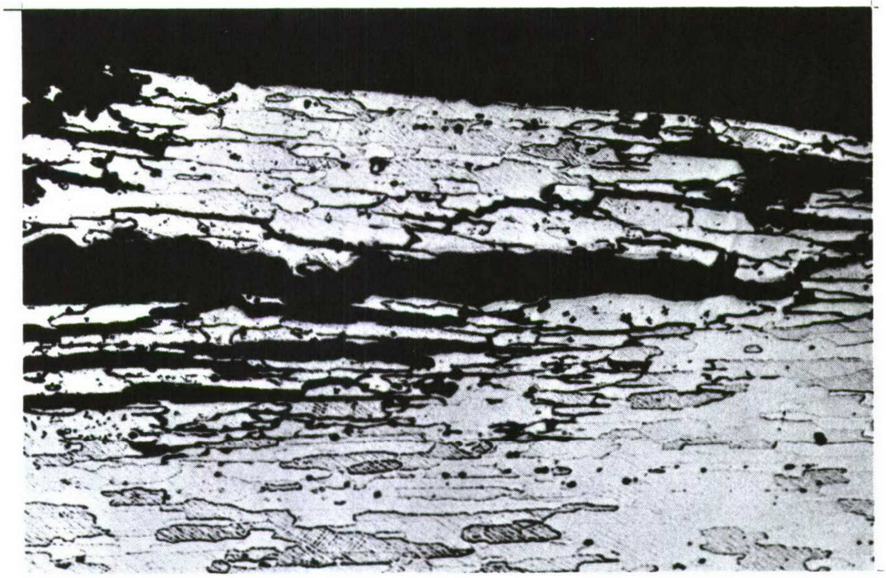
Fig. 92

S. No. 410658
0.125-in. 7475-T61
Exfoliation-C Degree

S. No. 410655
0.090-in. 7475-T61
Exfoliation-A Degree

S. No. 410671
0.188-in. 7475-T761
Pitting

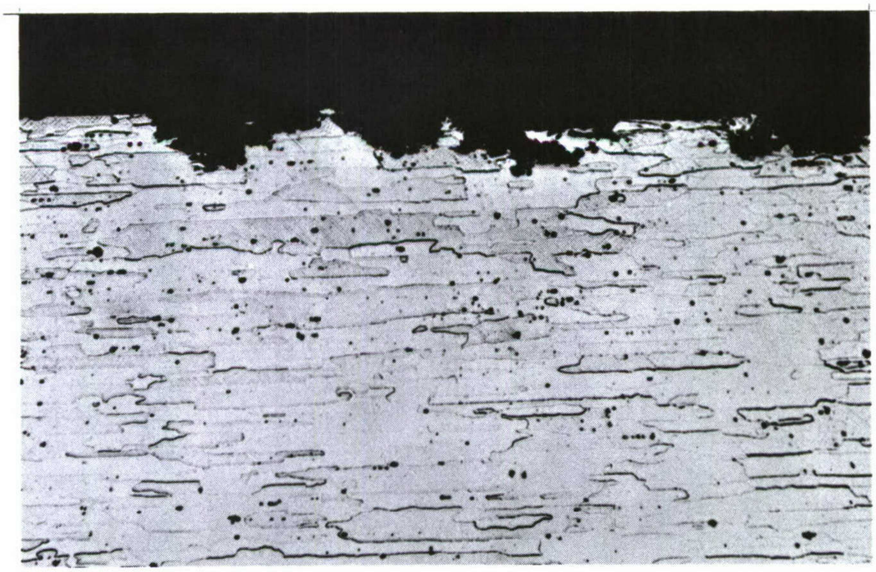
Fig. 93 Illustrates Visual Appearance of the 7475 Sheet After 48 Hours Exposure to EXCO. One Lot, S. No. 410658, in the T61 Temper Showed Appreciable Exfoliation, While all Other T61 Sheets, Represented by S. No. 410655, Showed Only Slight Exfoliation. All the T761 Sheets, Represented by S. No. 410671, Showed Only Pitting Corrosion. The Metallographic Appearance of the Attack in T61 Sheets Showing Exfoliation to an A Degree and of T761 Sheets Showing Only Pitting is Illustrated in Fig. 94.



Neg. 185871A Mag: 100X

S. No. 410659, 0.188-in. Thick Etch-Keller's

Longitudinal Section Through a 7475-T61 Sheet that was Rated Visually as E-A. Although Visually the Attack has an Appearance Somewhat Like Pit-Blistering (Fig. 93), Metallographic Examination Clearly Showed it was Exfoliation Resulting from Intergranular Attack.

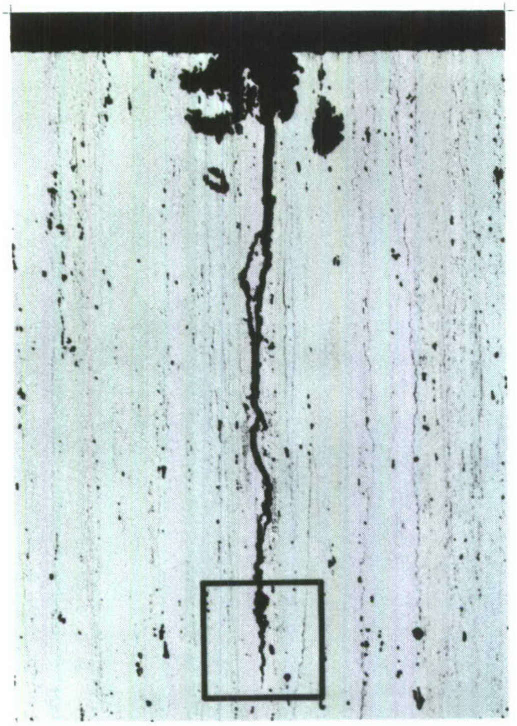


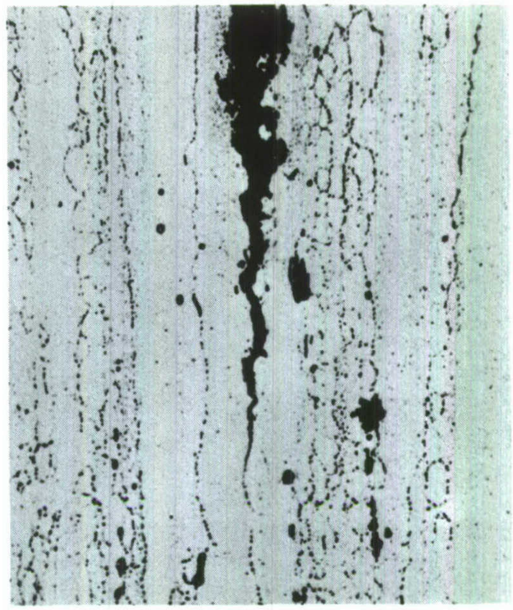
Neg. 186445A Mag: 100X

S. No. 410671, 0.188-in. Thick Etch-Keller's

Longitudinal Section Through a Representative 7475-T761 Sheet Showing Attack is Strictly Pitting.

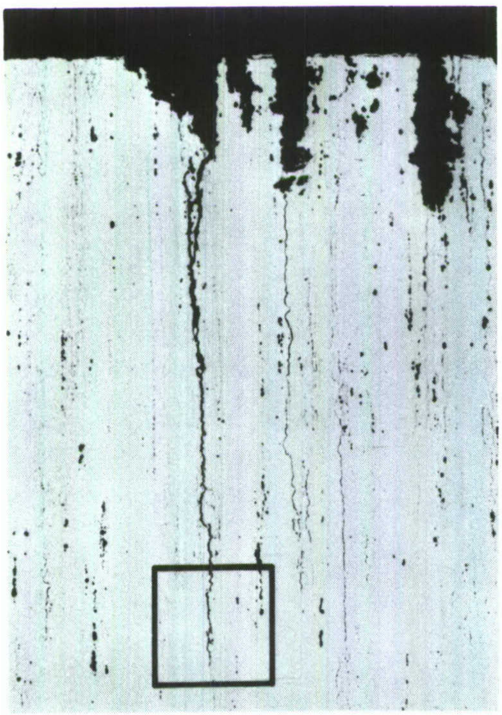
Fig. 94 Photomicrographs Showing Corrosive Attack in 7475-T61 and T761 Sheet Exposed 48 Hours to EXCO.

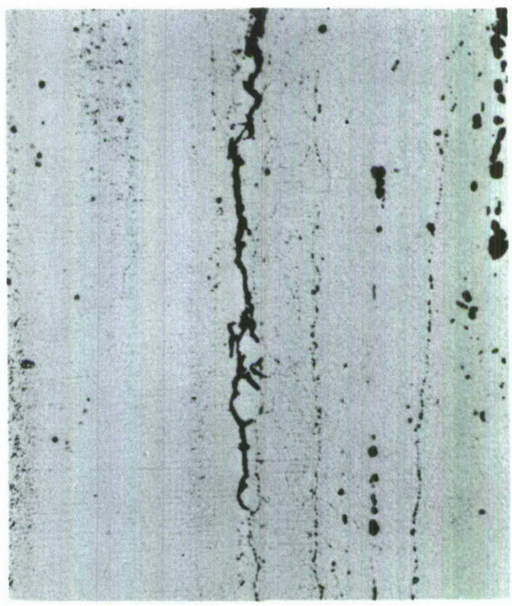




S. No. 410695-N7 Mag: 100X Mag: 500X

7049-T73, Stressed 45 ksi, Failed at 44 Days





S. No. 410983-N95 Mag: 100X Mag: 500X

7175-T736, Stressed 35 ksi, Failed at 56 Days

Fig. 95 Photomicrographs Showing Auxiliary Intergranular Cracks in Failed 7049-T73 and 7175-T736 Die Forging Specimens. All the Die Forging Specimens Contained Such Intergranular Cracks, Hence it was Concluded that All Failed Specimens should be Regarded as Legitimate SCC Failures, Even Though Certain Specimens also Contained Auxiliary Transgranular Cracks.

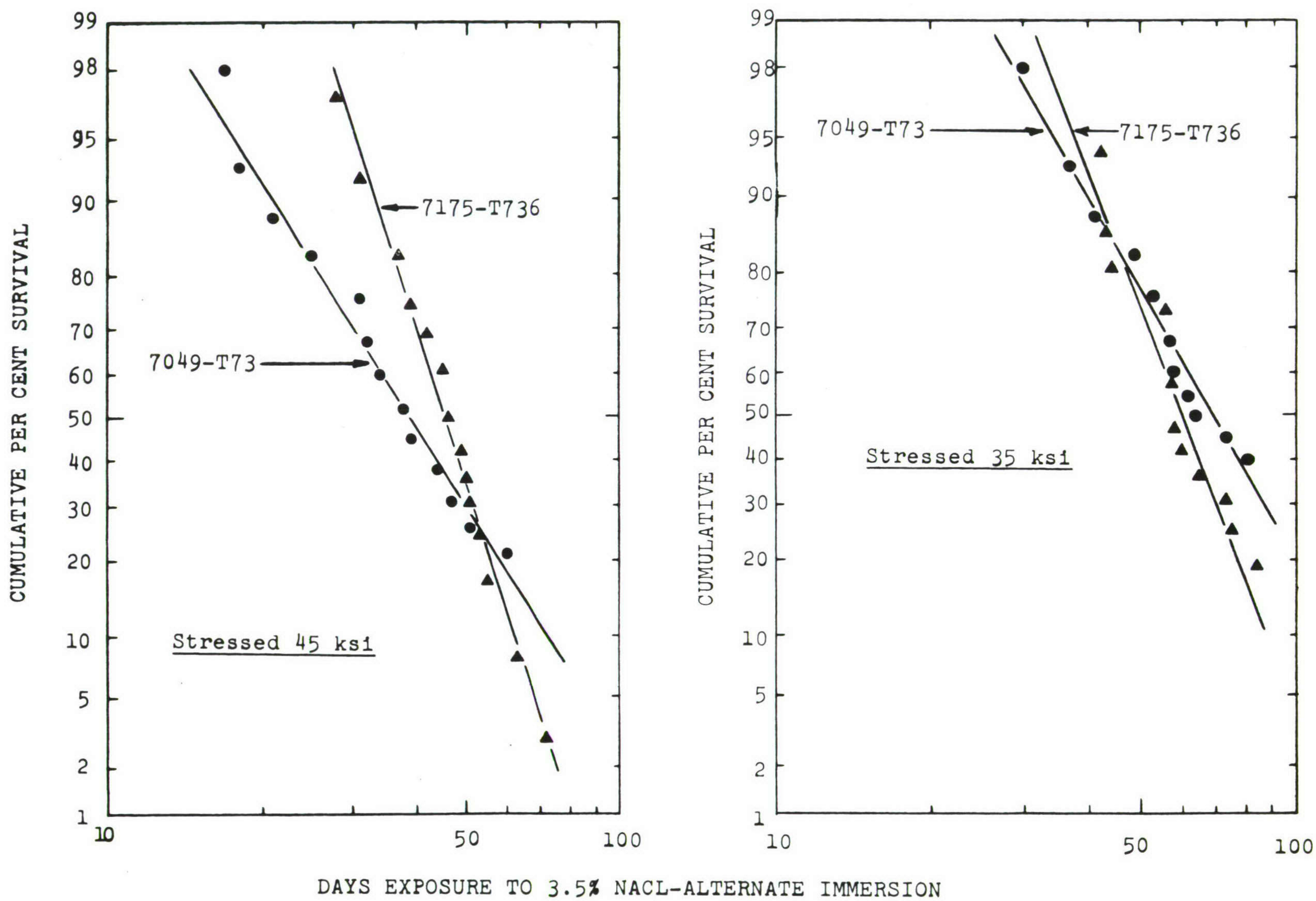
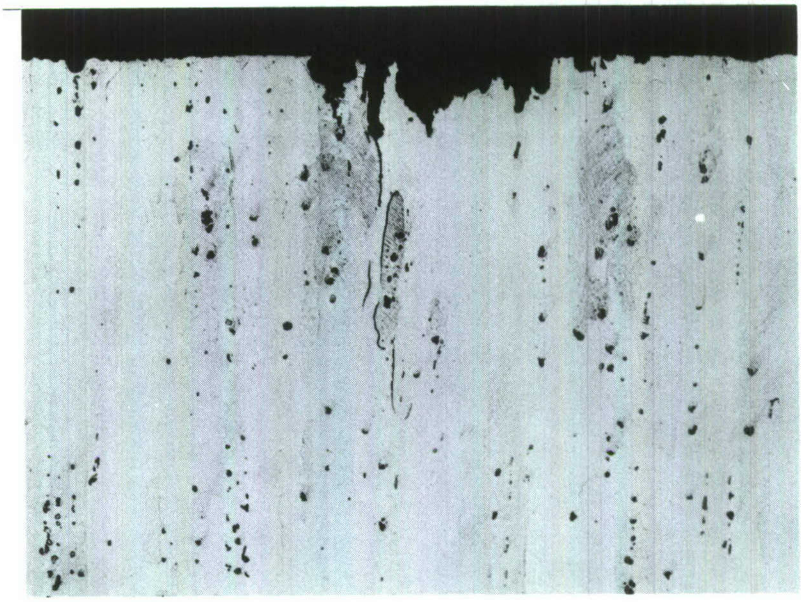


Fig. 96 Comparison of Per Cent Survival for Short-Transverse 1/8-in. Diameter Specimens from 7049-T73 and 7175-T736 Die Forgings that Permitted a Specimen Perpendiuclar to and across the Parting Plane.

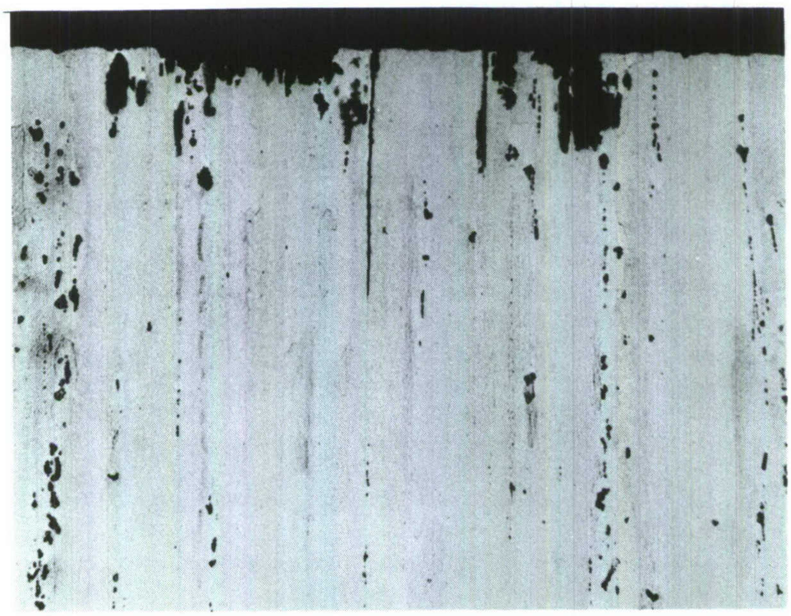
Fig. 96



S. No. 410675-CN10

Mag: 100X
Etch: Keller's

Short-Transverse Specimen from 1-3/4-in. 2124-T851 Plate. Specimen was Stressed to 50% Yield Strength and Failed after 7 Days Exposure to the Alternate Immersion Test.



S. No. 410680-CN10

Mag: 100X
Etch: Keller's

Short-Transverse Specimen from 2-in. 2124-T851 Plate. Specimen was stressed 50% Yield Strength and Failed After 27 Days Exposure to the Alternate Immersion Test.

Fig. 97 Photomicrographs Showing Presence of Intergranular Auxiliary Cracks in the Fractured Specimens from the Thin 2124-T851 Plates Indicating SCC as the Probable Cause of Failure.

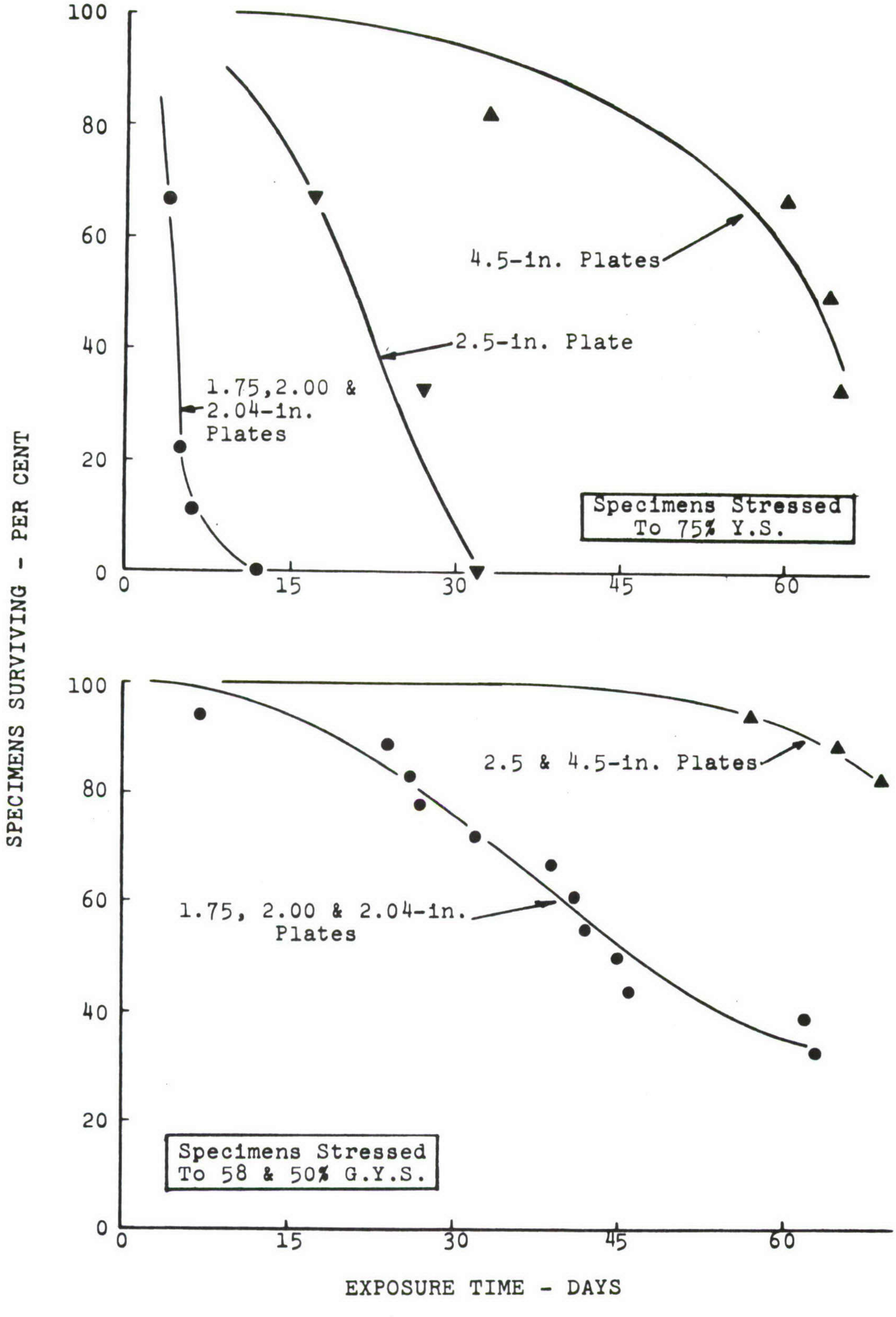
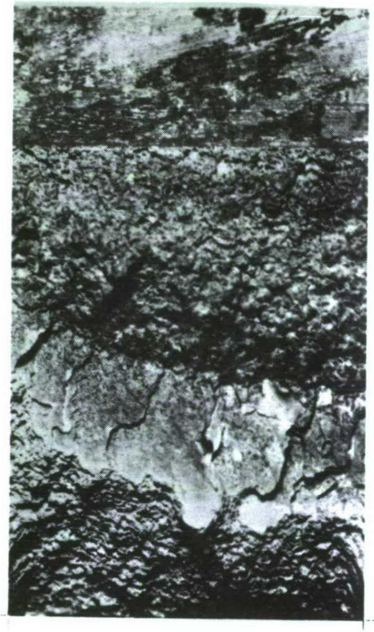


Fig. 98 Per Cent Survival of Short-Transverse Specimens of 2124-T851 Plate Exposed to 3.5% NaCl Alternate Immersion Showing the Better Performance of the Thicker Plate.

Fig. 98

Edge Center



Precrack

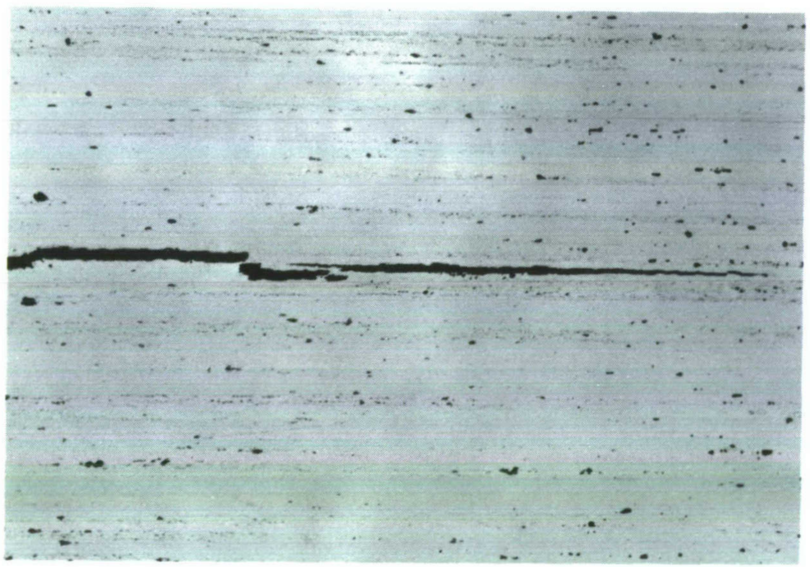
Environmental Growth

Center Edge

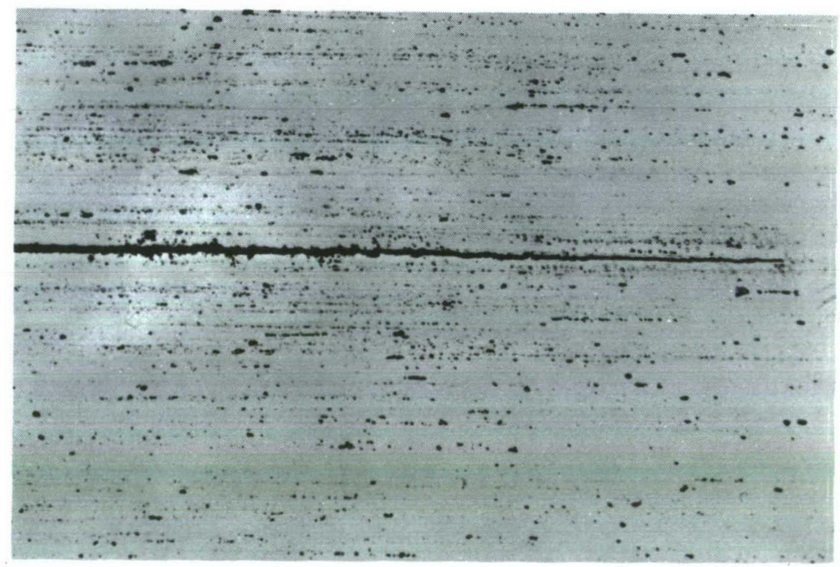
S. No. 410693-SL2W Mag: 5X

S. No. 410983-SL2W Mag: 5X

Photomacrographs of Fractured Faces after 30 Day Test.



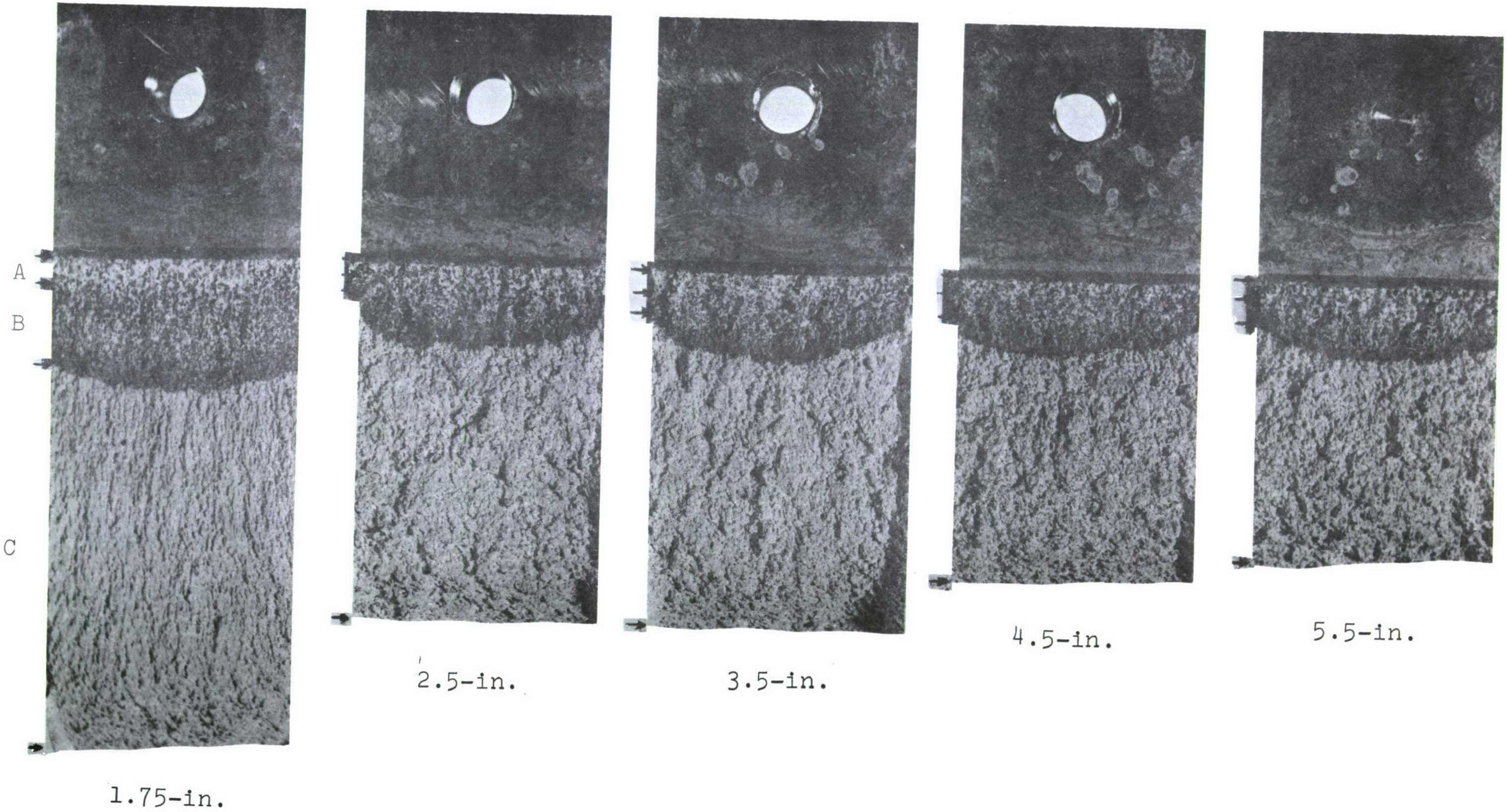
S. No. 410693-SL2W 7049-T73 Mag: 100X



S. No. 410983-SL2W 7175-T736 Mag: 100X

Photomicrographs of Tip of the Crack in the DCB Specimens.

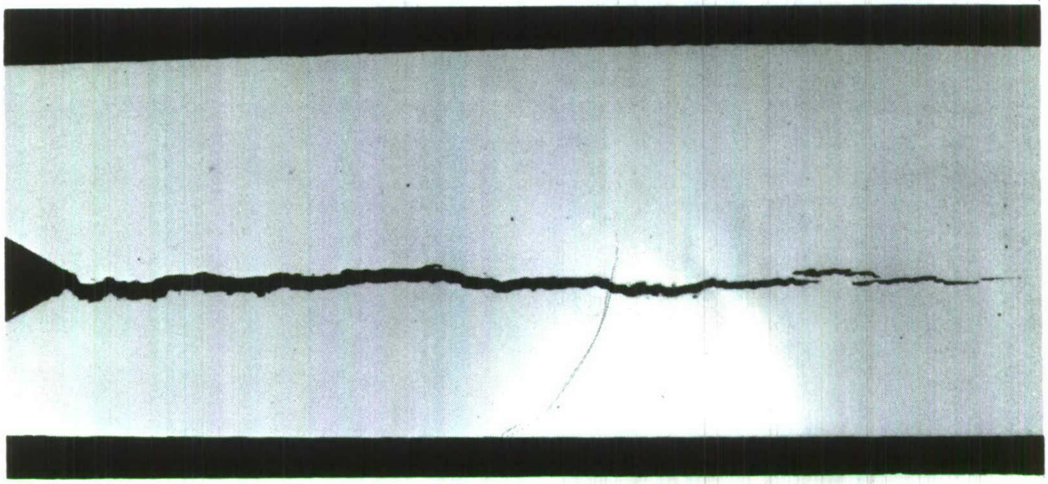
Fig. 99 DCB Specimens from Web Region of 7049-T73 and 7175-T736 Die Forgings.



Mag: 2X

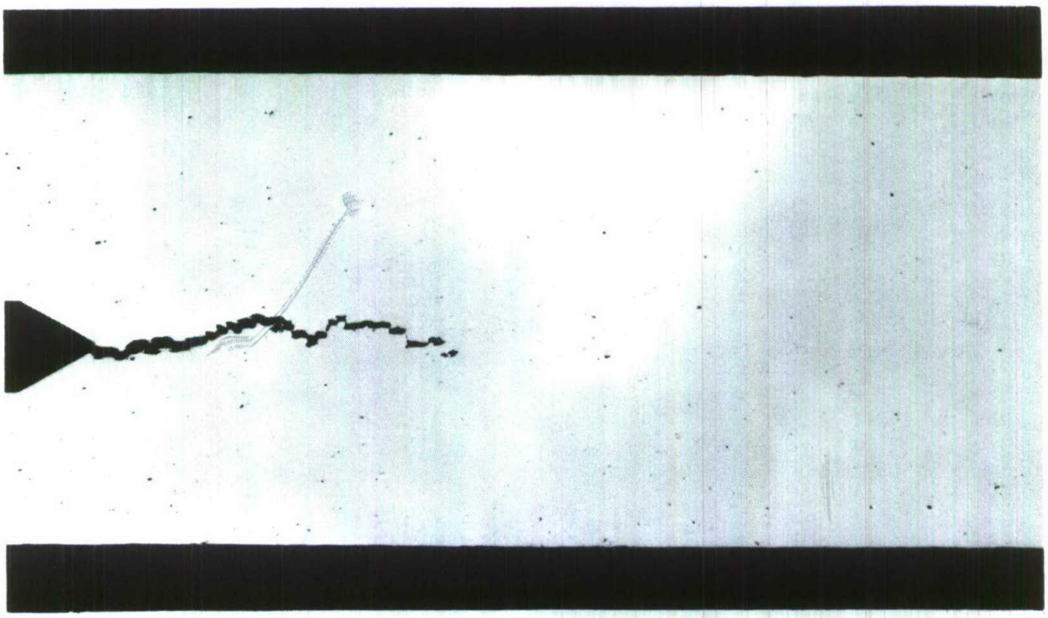
Fig. 100 Fractured Faces of DCB Specimens from 2124-T851 Plate by Producer A after Being Forced Fractured at the Conclusion of the 30 Day Test. Arrows Indicate: (A) Precrack, (B) Environmental Growth and (C) Final Forced Fracture.

Fig. 100



S. No. 410675-SL2 Mag: 10X

Photomacrograph of Total Crack in DCB Specimen from 1.75-in. 2124-T851 Plate at the Mid-width of the Specimen. The Intergranular Nature of the Tip of the Crack is shown at Higher Magnification in Fig. 102.

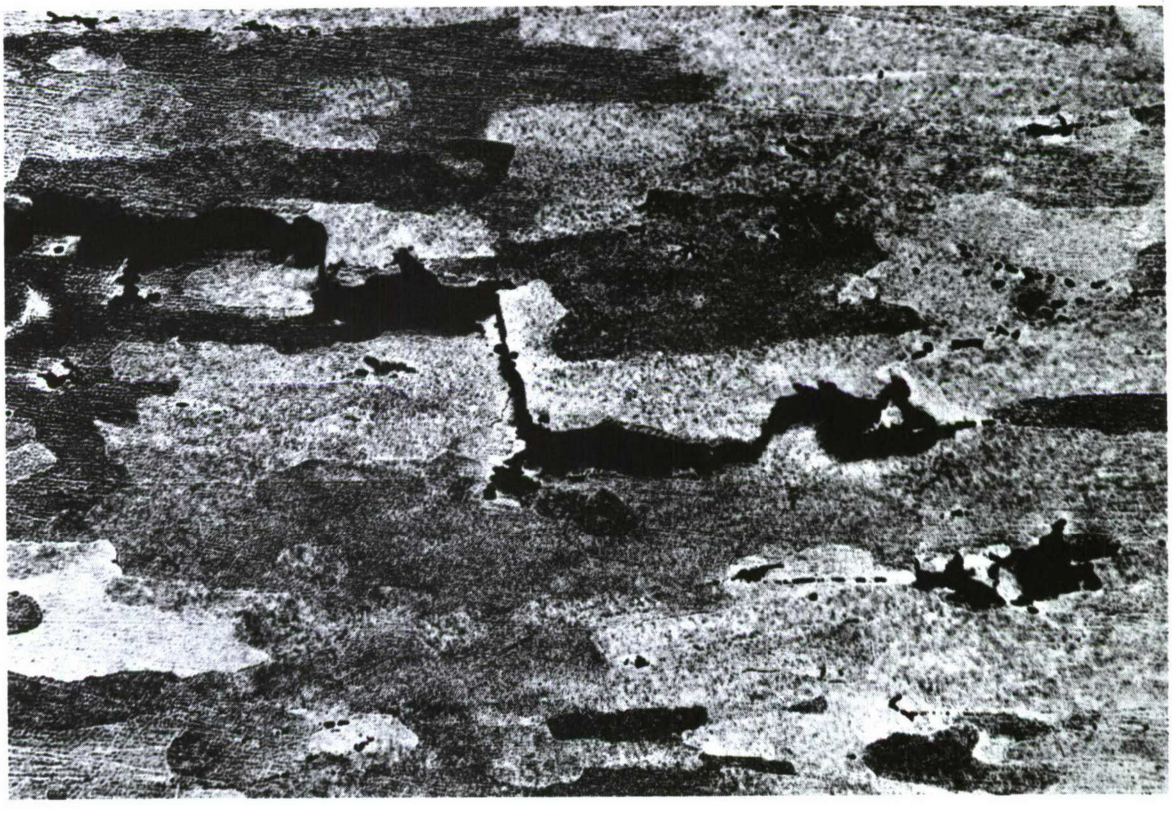


S. No. 410679-SL2 Mag: 10X

Photomicrograph of Total Crack in DCB Specimen from 5.5-in. 2124-T851 Plate at the Mid-width of the Specimen. The Crack is much Shorter than in the 1.75-in. Plate and Completely Tensile in Nature (See Fig. 102). Photomicrograph is also Representative of the Cracking 2.5, 3.5 and 4.5-in. Thick Plates.

S. No. 410675-SL2 Mag: 100X

Photomicrograph of Tip of the Crack in the DCB Specimen from 1.75-in. 2124-T851 Plate Showing the Intergranular Nature Indicative of SCC.



S. No. 410679-SL2 Mag: 100X

Fig. 102 Photomicrograph of the Tip of the Crack in DCB Specimen from 5.5-in. 2124-T851 Plate. Crack Characteristics are Transgranular Similar to that of the Precrack.

TABLE I

CHEMICAL COMPOSITIONS OF 7049-T73 AND 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Thickness Range, in.	Die No.	Producer	Element, % Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Be
7049-T73	410693	≤1.000	9078	A	0.07	0.14	1.46	0.02	2.27	0.15	0.00	7.47	0.01	0.002
	410698	1.001-2.000	15789	A	0.06	0.12	1.52	0.00	2.48	0.17	0.00	7.46	0.02	0.001
	410694		B5786	B	0.06	0.15	1.65	0.01	2.83	0.15	0.00	8.07	0.01	0.001
	410697		40005	A	0.08	0.14	1.48	0.02	2.38	0.16	0.00	7.37	0.01	0.002
	410695	2.001-3.000	40006	A	0.07	0.14	1.48	0.02	2.30	0.15	0.00	7.23	0.01	0.002
	410696		B6204	B	0.06	0.14	1.56	0.01	2.53	0.15	0.00	7.88	0.01	0.001
	410700	4.001-5.000	B2362	B	0.05	0.09	1.53	0.00	2.72	0.15	0.00	7.67	0.03	0.003
Limits* (maximum unless range is shown)					0.25	0.35	1.2-1.9	0.20	2.0-2.9	0.10-0.22	--	7.2-8.2	0.10	0.05
7175-T736	410983	≤1.000	9078	A	0.09	0.11	1.60	0.01	2.53	0.20	0.00	5.91	0.02	0.002
	410699	1.001-2.000	15789	A	0.06	0.12	1.66	0.00	2.42	0.22	0.00	5.69	0.02	0.001
	410704		F17961	A	0.06	0.11	1.59	0.00	2.43	0.18	0.00	5.54	0.01	0.001
	410705		40005	A	0.09	0.09	1.49	0.00	2.45	0.21	0.00	5.59	0.01	0.000
	410706		F17976	A	0.07	0.14	1.67	0.01	2.52	0.19	0.00	5.65	0.01	0.001
	410984	2.001-3.000	40006	A	0.09	0.11	1.59	0.00	2.53	0.20	0.00	5.85	0.02	0.002
Limits* (maximum unless range is shown)					0.15	0.20	1.2-2.0	0.10	2.1-2.9	0.18-0.30	--	5.1-6.1	0.10	0.05

* Aluminum Association Alloy Designations and Chemical Composition Limits for Wrought Aluminum Alloys, revised March, 1972.

TABLE II

CHEMICAL COMPOSITIONS OF 7049-T73 AND 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Dimensions, in.	Producer	Element, % Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Be
7049-T73	411019	2x16	A	0.13	0.25	1.67	0.03	2.54	0.15	0.03	8.25	0.04	0.003
	410686	3x16	A	0.07	0.11	1.59	0.00	2.49	0.17	0.00	7.54	0.02	0.001
	410966	4x16	A	0.07	0.11	1.54	0.00	2.47	0.17	0.00	7.43	0.02	0.001
	410688	5x20	A	0.06	0.12	1.59	0.00	2.52	0.17	0.00	7.54	0.02	0.001
Limits* (Maximum unless range is shown)				0.25	0.35	1.2-1.9	0.20	2.0-2.9	0.10-0.22	--	7.2-8.2	0.10	0.05
7175-T736	410689	2x16	A	0.07	0.14	1.58	0.01	2.25	0.22	0.00	5.42	0.02	0.002
	410985	3x12	A	0.08	0.13	1.70	0.01	2.41	0.22	0.00	5.81	0.02	0.001
	410691	4x16	A	0.08	0.14	1.61	0.01	2.26	0.22	0.00	5.45	0.02	0.002
	410986	5x20	A	0.08	0.13	1.53	0.01	2.33	0.20	0.00	5.61	0.02	0.001
Limits* (Maximum unless range is shown)				0.15	0.20	1.2-2.0	0.10	2.1-2.9	0.18-0.30	--	5.1-6.1	0.10	0.05

* Aluminum Association Alloy Designations and Chemical Composition Limits for Wrought Aluminum Alloys, revised March, 1972.

TABLE III

CHEMICAL COMPOSITIONS OF 7475-T61 AND T761 SHEET
(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Producer	Element, % Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Be
410888	0.032	A	0.05	0.09	1.47	0.00	2.21	0.21	0.00	5.48	0.02	0.001
410651	0.040	A	0.06	0.07	1.54	0.00	2.32	0.19	0.00	5.46	0.01	0.001
410652		A	0.07	0.10	1.65	0.00	2.33	0.20	0.00	5.70	0.02	0.001
410663		A	0.07	0.10	1.65	0.00	2.33	0.20	0.00	5.70	0.02	0.001
410664		A	0.06	0.07	1.54	0.00	2.32	0.19	0.00	5.46	0.01	0.001
410653	0.063	A	0.06	0.09	1.49	0.00	2.28	0.20	0.00	5.66	0.02	0.001
410654		A	0.07	0.07	1.55	0.01	2.40	0.19	0.00	5.66	0.02	0.001
410665		A	0.06	0.06	1.59	0.00	2.29	0.20	0.00	6.04	0.02	0.002
410666		A	0.07	0.07	1.55	0.01	2.40	0.19	0.00	5.66	0.02	0.001
410655	0.090	A	0.06	0.07	1.54	0.00	2.32	0.19	0.00	5.46	0.01	0.001
410656		A	0.07	0.10	1.65	0.00	2.33	0.20	0.00	5.70	0.02	0.001
410667		A	0.06	0.07	1.54	0.00	2.32	0.19	0.00	5.46	0.01	0.001
410668		A	0.07	0.10	1.65	0.00	2.33	0.20	0.00	5.70	0.02	0.001
410657	0.125	A	0.05	0.07	1.61	0.00	2.00	0.20	0.00	5.86	0.04	0.001
410658		A	0.07	0.07	1.55	0.01	2.40	0.19	0.00	5.66	0.02	0.001
410669		A	0.06	0.09	1.53	0.00	2.28	0.20	0.00	5.59	0.02	0.001
410670		A	0.07	0.07	1.55	0.01	2.40	0.19	0.00	5.66	0.02	0.001
410659	0.188	A	0.06	0.09	1.50	0.00	2.21	0.20	0.00	5.66	0.02	0.001
410660		A	0.06	0.09	1.61	0.00	2.23	0.20	0.00	5.62	0.02	0.001
410671		A	0.06	0.09	1.50	0.00	2.21	0.20	0.00	5.66	0.02	0.001
410672		A	0.06	0.09	1.61	0.00	2.23	0.20	0.00	5.62	0.02	0.001
410661	0.249	A	0.06	0.08	1.44	0.02	2.02	0.18	0.00	6.02	0.02	0.001
410662		A	0.06	0.09	1.50	0.00	2.21	0.20	0.00	5.66	0.02	0.001
410673		A	0.07	0.07	1.55	0.01	2.40	0.19	0.00	5.66	0.02	0.001
410674		A	0.06	0.09	1.50	0.00	2.21	0.20	0.00	5.66	0.02	0.001
Limits*	**(Maximum unless range is shown)**		0.1	0.12	1.2-1.9	0.06	1.9-2.6	0.18-0.25	0.00	5.2-6.2	0.06	0.05

* **Aluminum Association Alloy Designations** and **Chemical Composition Limits for Wrought Aluminum Alloys, revised** March, 1972.

TABLE IV

CHEMICAL COMPOSITIONS OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample		Producer	Element, %								
Number	Thickness, in.		Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti
410675	1.750	A	0.05	0.09	4.37	0.62	1.53	0.00	0.00	0.01	0.00
410680	2.000	C	0.05	0.14	4.08	0.55	1.39	0.00	0.00	0.03	0.02
410681	2.040	B	0.13	0.21	4.25	0.33	1.47	0.01	0.00	0.07	0.03
410676	2.500	A	0.06	0.05	4.20	0.74	1.40	0.00	0.00	0.00	0.02
410677	3.500	A	0.06	0.09	4.27	0.61	1.41	0.00	0.00	0.00	0.01
410682	4.000	B	0.08	0.19	4.23	0.36	1.45	0.01	0.00	0.19	0.04
410678	4.500	A	0.05	0.09	4.37	0.62	1.53	0.00	0.00	0.01	0.00
410683	4.500	C	0.04	0.10	4.12	0.42	1.30	0.00	0.00	0.02	0.01
410679	5.500	A	0.04	0.07	4.32	0.63	1.49	0.00	0.00	0.00	0.00
410684	6.000	C	0.04	0.11	4.00	0.49	1.36	0.00	0.00	0.02	0.01
Limits* (Maximum unless range is shown)			0.2	0.3	3.8-4.9	0.3-0.9	1.2-1.8	0.10	--	0.25	0.05

* Interim Federal Specification QQ-A-00250/29.

TABLE V

MECHANICAL PROPERTIES OF 7049-T73 DIE FORGINGS

(F33615-71-C-1571)

Sample			Die No.	Producer	Tensile				Compressive	Shear	Bearing‡‡ Edgewise			
											Ultimate Strength, ksi		Yield Strength,† ksi	
Number	Thickness Range, in.	Direction‡			Ultimate Strength, ksi	Yield Strength,* ksi	Elong. in 4D, %	Reduction of Area, %	Yield Strength,* ksi	Ultimate Strength, ksi	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410693	≤1.000	L	9078	A	81.3	74.5	13.5	32	75.5	45.1	114.9	148.0	92.7	114.2
		ST			71.9	61.8	10.0	22	65.5	43.9	--	--	--	--
410698	1.001-2.000	L	15789	A	81.3	74.9	15.0	37	79.8	52.9	120.3	162.5	102.4	120.3
		ST			78.4	70.8	8.0	10	76.7	49.7	--	--	--	--
410694		L	B5786	B	75.9	67.0	13.5	30	68.8	47.3	107.2	152.7	94.9	122.1
		ST			75.4	66.1	10.9	5	68.0	46.9	--	--	--	--
410697A		L	40005	A	77.8	71.6	11.0	30	80.1	45.8	117.4	151.6	97.1	116.7
		ST			75.3	67.6	7.1	16	71.1	43.9	--	--	--	--
410697C		L	40005	A	80.8	74.4	11.5	25	78.5	43.5	--	--	--	--
		ST			73.4	67.1	7.8	10	69.7	--	--	--	--	--
410695	2.001-3.000	L	40006	A	80.3	73.1	12.5	26	74.6	45.3	113.1	146.8	95.2	113.5
		ST			74.3	66.3	8.0	9	68.0	44.6	--	--	--	--
410696		L	B6204	B	75.0	65.5	13.5	35	72.1	47.6	123.6	146.7	104.7	114.0
		ST			73.7	64.7	7.0	8	66.7	45.5	--	--	--	--
410697B		L	40005	A	81.6	75.9	11.5	28	79.6	44.8	119.1	149.6	97.8	113.0
		ST			73.9	64.9	8.0	15	69.0	43.7	--	--	--	--
410700	4.001-5.000	L	B2362	B	76.5	65.7	12.5	26	70.1	44.8	110.6	138.8	97.0	113.8
		ST			73.3	65.5	2.9	4	68.3	44.1	--	--	--	--

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡‡ L-Longitudinal, ST-Short Transverse
‡‡ Specimens and fixtures cleaned ultrasonically

TABLE VI

MECHANICAL PROPERTIES OF 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Sample					Tensile				Compressive	Shear	Bearing‡‡ Edgewise			
											Ultimate Strength, ksi		Yield Strength†, ksi	
Number	Thickness Range, in.	Direction‡	Die No.	Producer	Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 4D, %	Reduction of Area, %	Yield Strength,* ksi	Ultimate Strength, ksi	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410983	≤1.000	L	9078	A	77.5	69.3	14.0	37	71.3	45.1	113.3	143.5	94.4	105.6
		ST			73.4	62.2	7.9	12	66.5	43.2	--	--	--	--
410699	1.000-2.000	L	15789	A	81.4	74.7	13.0	34	75.1	47.4	116.9	153.9	96.0	126.1
		ST			75.4	67.0	8.0	14	71.2	48.5	--	--	--	--
410704		L	F17961	A	82.9	76.9	13.0	34	79.5	47.4	121.3	158.0	101.3	119.3
		ST			77.4	68.4	9.0	11	72.6	46.2	--	--	--	--
410705A		L	40005	A	77.2	69.8	12.0	30	77.8	46.5	116.7	155.5	97.0	116.3
		ST			73.2	65.2	8.6	17	69.0	44.4	--	--	--	--
410705C		L	40005	A	79.1	72.4	13.0	36	75.2	44.6	--	--	--	--
		ST			75.1	67.4	9.4	17	70.9	--	--	--	--	--
410706		L	F17976	A	82.7	73.2	12.0	29	75.4	48.3	103.2	154.2	93.1	116.8
		ST			75.5	66.7	8.0	12	69.8	48.1	--	--	--	--
410705B	2.001-3.000	L	40005	A	78.5	71.8	12.5	35	76.2	45.3	117.5	151.6	100.0	115.9
		ST			74.2	66.4	7.0	15	68.5	44.4	--	--	--	--
410984		L	40006	A	76.9	68.0	15.5	38	68.8	45.7	109.9	141.0	90.2	103.1
		ST			73.6	62.6	9.0	12	65.7	43.5	--	--	--	--

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡ L-Longitudinal, ST-Short Transverse.
‡‡ Specimens and Fixtures cleaned ultrasonically.

TABLE VII

MECHANICAL PROPERTIES OF 7049-T73 HAND FORGINGS

(F33615-71-C-1571)

Sample		Producer	Direction‡	Tensile				Compressive	Shear	Bearing‡‡ Edgewise			
										Ultimate Strength, ksi		Yield Strength, ksi†	
Number	Dimensions, in.			Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 4D, %	Reduction in Area, %	Yield Strength,* ksi	Ultimate Strength, ksi	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
411019	2x16	A	L	76.4	68.8	11.0	30	75.5	45.3	103.1	133.8	95.1	108.0
			LT	75.1	67.0	10.5	24	70.2	45.7	106.4	137.7	100.3	113.4
			ST	70.6	62.4	3.1	4	71.9	43.5	--	--	--	--
410686	3x16	A	L	74.2	65.4	13.0	34	66.5	44.8	118.0	153.0	101.4	118.2
			LT	75.2	66.2	11.5	27	67.0	42.3	107.0	139.1	88.2	105.8
			ST	72.2	62.3	7.5	12	65.4	43.2	--	--	--	--
410966	4x16	A	L	80.0	72.8	12.5	31	66.5	44.8	108.5	150.0	91.8	116.3
			LT	76.4	68.5	9.5	17	69.8	43.6	112.2	145.8	98.4	118.8
			ST	75.5	67.5	7.9	16	73.4	44.2				
410688	5x20	A	L	70.3	60.1	13.5	31	62.6	42.6	98.1	139.9	86.2	107.5
			LT	68.4	58.1	12.0	23	62.1	40.7	100.3	126.8	86.4	105.5
			ST	68.1	59.1	6.0	6	61.3	41.2	--	--	--	--

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡ L-Longitudinal; LT-Long-transverse; ST-Short-transverse.
‡‡ Specimens and fixtures cleaned ultrasonically.

TABLE VIII

MECHANICAL PROPERTIES OF 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Sample				Tensile				Compressive	Shear	Bearing‡‡ Edgewise			
										Ultimate Strength, ksi		Yield Strength, ksi†	
Number	Dimensions, in.	Producer	Direction‡	Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 4D, %	Reduction in Area, %	Yield Strength,* ksi	Ultimate Strength, ksi	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410689	2x16	A	L	75.5	67.2	14.0	38	70.1	45.1	116.0	149.4	99.6	114.7
			LT	73.5	65.4	14.0	36	70.3	41.4	105.5	146.6	96.6	110.1
			ST	74.1	66.4	10.9	23	69.0	45.3	--	--	--	--
410985	3x12	A	L	77.7	70.8	14.5	40	68.8	48.0	109.9	147.3	97.1	113.1
			LT	74.3	65.7	10.0	20	69.8	47.6	112.0	143.4	93.8	107.0
			ST	74.7	65.6	7.0	11	70.3	44.6	--	--	--	--
410691	4x16	A	L	72.8	62.4	13.0	32	67.5	42.8	114.5	134.3	97.7	104.0
			LT	70.8	59.9	10.0	19	64.7	41.1	104.5	135.6	85.0	104.0
			ST	71.4	61.4	8.6	15	63.9	41.4	--	--	--	--
410986	5x20	A	L	72.5	62.1	14.0	34	62.9	43.0	96.1	129.4	82.9	98.7
			LT	69.5	60.1	13.5	39	66.0	43.1	105.9	133.3	88.3	102.9
			ST	68.9	58.5	6.5	7	63.7	40.0	--	--	--	--

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡ L-Longitudinal; LT-Long-Transverse; ST-Short Transverse.
‡‡ Specimens and fixtures cleaned ultrasonically.

TABLE IX

MECHANICAL PROPERTIES OF 7475-T61 SHEET

(F33615-71-C-1571)

Sample				Tensile			Compressive	Shear	Bearing‡‡			
									Flatwise			
									Ultimate Strength, ksi		Yield Strength, ksi†	
Number	Thickness, in.	Direction‡	Producer	Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 2 in., %	Yield Strength,* ksi	Ultimate Strength, ksi	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410651	0.040	L	A	81.5	76.2	11.0	71.1	49.7#	126.6	159.4	99.2	119.5
		T		81.3	72.9	11.0	76.9	--	125.2	164.1	100.3	115.9
410652		L	A	83.1	77.1	10.5	72.8	50.3#	129.0	173.4	102.8	114.1
		T		79.8	72.1	11.0	75.5	--	128.8	167.2	103.1	118.0
410653	0.063	L	A	79.8	74.1	11.0	75.0	48.2#	132.5	168.2	106.4	117.2
		T		80.8	72.6	12.0	77.6	--	132.5	166.9	106.4	122.9
410654		L	A	81.9	75.7	11.0	71.3	48.9#	132.9	165.5	103.2	118.7
		T		82.3	73.8	11.0	78.1	--	132.3	165.2	105.8	120.6
410655	0.090	L	A	80.3	74.2	11.0	72.9	--	128.8	165.8	108.8	120.2
		T		80.4	72.1	11.5	76.3	--	128.9	164.7	110.3	122.8
410656		L	A	80.1	73.7	11.0	73.4	--	128.9	164.9	108.6	122.3
		T		80.4	71.9	12.0	76.2	--	129.8	166.6	110.5	125.0
410657	0.125	L	A	79.5	74.5	13.0	74.5	--	132.2	164.7	115.0	129.5
		T		80.4	72.6	13.0	77.3	--	131.7	164.4	112.3	129.1
410658		L	A	82.0	76.8	11.5	76.1	--	134.4	167.8	113.6	131.2
		T		82.2	73.1	11.5	77.9	--	134.1	166.7	116.2	132.5
410659	0.188	L	A	80.4	75.0	12.5	71.8	--	128.8	164.2	109.0	124.2
		T		79.4	72.3	13.0	76.7	--	127.3	163.9	109.2	126.7
410660		L	A	80.2	75.6	13.0	73.3	52.6	129.8	167.2	110.0	127.7
		T		80.1	72.6	13.0	77.4	52.4	128.9	166.3	110.8	126.9
410661	0.249	L	A	79.5	75.3	13.0	77.1	51.8	127.4	165.2	109.3	124.4
		T		80.8	73.4	13.0	77.0	51.0	127.7	164.1	110.3	128.0
410662		L	A	81.9	77.4	13.5	75.9	53.3	131.0	167.9	112.2	132.4
		T		83.1	75.0	13.5	80.1	53.3	130.9	165.7	111.8	131.7

* Offset equals 0.2 per cent
† Offset equals 2 per cent of pin diameter.
‡ L-Longitudinal, T-Transverse.
\# Punch-type shear specimens, all others cylindrical.
‡‡ Specimens and fixtures cleaned ultrasonically.

TABLE X

MECHANICAL PROPERTIES OF 7475-T761 SHEET

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Direction‡	Producer	Tensile Ultimate Strength, ksi	Tensile Yield Strength,* ksi	Tensile Elong in 2 in., %	Compressive Yield Strength,* ksi	Shear Ultimate Strength, ksi	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=1.5	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=2.0	Bearing‡‡ Flatwise Yield Strength, ksi† e/D=1.5	Bearing‡‡ Flatwise Yield Strength, ksi† e/D=2.0
410888	0.032	L	A	79.7	72.8	9.0	71.8	48.3#	116.4	161.7	92.0	111.4
		T		77.8	69.4	10.0	73.2	--	124.5	159.2	99.5	114.0
410663	0.040	L	A	80.0	73.7	11.0	70.7	48.3#	119.6	155.4	96.7	108.9
		T		78.3	70.8	10.5	73.3	--	121.2	160.8	98.3	116.6
410664		L	A	81.3	74.3	10.5	70.8	49.4#	128.1	166.7	94.9	118.8
		T		78.9	71.1	11.0	73.5	--	125.7	170.4	99.0	112.4
410665	0.063	L	A	79.0	70.5	10.0	73.3	48.2#	124.5	156.1	98.7	115.5
		T		76.9	69.0	10.5	74.4	--	125.2	157.4	100.0	116.8
410666		L	A	75.2	66.4	11.0	65.8	45.5#	120.5	154.8	96.2	112.6
		T		75.3	65.0	11.0	68.4	--	121.0	154.8	98.7	116.1
410667	0.090	L	A	75.0	67.3	12.0	65.4	--	119.5	154.0	99.6	111.4
		T		74.1	64.6	11.5	67.7	--	118.4	152.0	99.3	111.1
410668		L	A	77.1	69.8	12.0	69.2	--	124.4	159.5	104.9	115.3
		T		77.2	68.3	12.0	72.8	--	122.5	157.6	103.0	114.2
410669	0.125	L	A	74.2	66.4	12.0	65.2	--	121.7	152.7	103.5	118.6
		T		75.3	64.9	12.0	69.5	--	119.2	151.1	101.0	117.8
410670		L	A	74.8	66.8	12.0	65.5	--	121.9	153.4	102.5	116.9
		T		76.0	65.6	11.5	69.4	--	122.2	152.8	104.6	120.4
410671	0.188	L	A	73.4	66.4	14.0	63.6	47.2	118.1	150.0	99.1	114.7
		T		73.9	65.3	13.0	67.6	46.9	117.1	148.8	99.1	114.8
410672		L	A	75.9	69.3	13.0	66.5	49.1	119.6	153.2	100.8	118.1
		T		75.3	67.0	13.5	68.9	47.3	119.5	151.3	101.1	116.7
410673	0.249	L	A	74.1	67.0	13.5	63.8	47.6	117.9	149.1	99.3	113.7
		T		74.9	65.9	14.0	68.4	47.9	117.0	150.0	97.4	116.4
410674		L	A	76.0	67.8	14.0	66.5	49.1	120.3	153.5	101.0	118.2
		T		77.3	68.3	14.0	71.7	49.4	120.2	153.2	100.6	121.1

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡ L-Longitudinal; T-Transverse.
\# Punch-type shear specimens, all others cylindrical.
‡‡ Specimens and fixtures cleaned ultrasonically.

TABLE XI

SUPPLEMENTAL MECHANICAL PROPERTIES OF BARE AND ALCLAD 7475-T61 AND T761 SHEET

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Thickness, in.	Direction‡	Producer	Tensile Ultimate Strength, ksi	Tensile Yield Strength,* ksi	Tensile Elong in 2 in., %	Compressive Yield Strength,* ksi	Shear Ultimate Strength, ksi	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=1.5	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=2.0	Bearing‡‡ Flatwise Yield Strength, ksi† e/D=1.5	Bearing‡‡ Flatwise Yield Strength, ksi† e/D=2.0
7475-T61	369704	0.063	L	A	81.9	75.6	10.5	74.1	49.6#	--	--	--	--
			T		80.4	81.6	10.5	79.2	--	--	--	--	--
	369544	0.090	L	A	81.0	76.0	11.8	75.7	--	131.9	168.7	112.1	127.0
			T		80.5	72.5	12.5	78.3	--	131.2	167.6	112.6	127.9
	369621		L	A	80.5	76.4	11.5	74.1	--	130.1	166.6	111.4	127.0
			T		80.6	73.0	12.0	77.9	--	129.6	166.7	110.4	130.0
	369598		L	A	82.4	75.9	11.3	77.5	--	133.3	171.6	114.0	126.4
			T		82.0	74.5	12.0	80.4	--	133.4	170.7	114.4	125.0
	369618		L	A	82.0	75.8	12.0	75.6	--	133.1	170.1	114.2	128.0
			T		82.0	74.1	12.0	80.0	--	132.8	169.7	113.0	129.5
	369597	0.125	L	A	78.3	73.4	12.3	73.4	--	127.6	164.0	106.5	123.7
			T		79.2	71.8	12.5	76.2	--	127.4	163.7	107.4	125.3
	369543		L	A	82.9	78.4	12.5	78.0	--	134.5	172.3	114.9	132.8
			T		83.0	73.6	12.0	80.4	--	136.0	172.2	118.0	136.8
	369548	0.188	L	A	80.6	77.3	12.8	75.5	--	132.8	169.7	115.8	129.4
			T		82.0	74.2	11.8	78.9	--	133.2	171.0	116.4	136.4
	369596		L	A	81.3	76.5	12.5	75.5	--	134.6	172.0	115.6	130.8
			T		81.6	73.4	12.8	78.1	--	134.1	171.2	116.0	134.7
	369516	0.249	L	A	79.2	74.8	13.0	72.6	50.6	129.0	164.1	111.2	129.7
			T		79.6	72.4	12.0	76.8	51.8	128.4	164.8	110.6	127.4
	369517		L	A	82.0	77.0	12.2	76.0	53.0	133.7	171.8	115.2	134.6
			T		82.2	75.2	12.5	79.0	52.6	133.6	172.0	114.2	136.7
-T761	369705	0.063	L	A	81.2	73.6	10.0	72.1	--	--	--	--	--
			T		79.0	71.4	10.2	73.4	--	--	--	--	--
	369615	0.090	L	A	74.2	66.6	11.5	66.8	--	119.4	151.8	101.6	114.0
			T		74.8	65.3	11.5	70.7	--	117.8	151.2		
	369613		L	A	78.3	70.7	11.5	71.6	--	125.6	161.8	105.2	121.1
			T		78.2	68.9	11.5	74.4	--	125.5	160.5		
	369599	0.125	L	A	74.2	67.0	12.8	65.8	--	119.6	153.6	100.5	116.6
			T		74.8	66.0	12.5	70.2	--	119.7	153.4		
	369542		L	A	80.4	75.2	11.5	75.8	--	129.6	166.2	110.1	127.9
			T		80.3	72.2	12.5	77.2	--	129.4	166.9		
	369509	0.249	L	A	73.8	66.6	14.2	63.3	47.9	116.7	151.4	98.4	116.2
			T		74.0	64.5	13.5	68.0	47.6	118.4	151.8	100.4	119.9
	369510		L	A	78.5	72.2	13.0	71.2	51.2	126.9	163.0	106.5	124.2
			T		78.5	70.6	12.5	73.6	50.8	125.8	162.6	104.6	126.7

(Continued)

TABLE XI
(Concluded)

SUPPLEMENTAL MECHANICAL PROPERTIES OF BARE AND ALCLAD 7475-T61 AND T761 SHEET

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Thickness, in.	Direction‡	Producer	Tensile Ultimate Strength, ksi	Tensile Yield Strength,* ksi	Tensile Elong in 2 in., %	Compressive Yield Strength,* ksi	Shear Ultimate Strength, ksi	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=1.5	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=2.0	Bearing‡‡ Flatwise Yield Strength, ksi† e/D=1.5	Bearing‡‡ Flatwise Yield Strength, ksi† e/D=2.0
Alc. 7475-T61	369505	0.040	L	A	73.2	65.6	11.2	67.6	46.0#	124.8	150.1	102.9	114.7
			T		72.4	64.8	11.2	68.2	--	120.8	138.8	98.0	109.6
	364506		L	A	78.3	71.3	10.0	67.9	47.7#	119.2	144.4	98.0	116.8
			T		73.2	66.0	9.5	70.8	--	127.2	136.4	99.7	112.0
	369594	0.063	L	A	76.9	69.8	11.8	69.4	46.1#	123.0	160.5	97.3	113.6
			T		75.6	67.2	11.5	72.0	--	124.4	160.4	100.4	111.8
	369616		L	A	75.6	69.3	11.3	68.6	46.0#	123.5	159.2	99.8	114.8
			T		74.8	66.5	11.3	71.4	--	123.8	160.9	100.0	117.8
	369620		L	A	79.7	73.0	10.5	71.2	48.1#	130.6	168.2	105.0	121.7
			T		78.1	70.2	11.0	75.1	--	130.2	167.4	106.4	122.9
	369617		L	A	78.7	71.8	10.8	70.8	47.6#	129.6	168.1	103.4	122.2
			T		76.8	68.4	11.0	74.4	--	129.6	168.8	107.0	126.6
	369456	0.090	L	A	76.2	68.8	11.5	66.7	--	120.6	156.2	100.2	119.2
			T		75.2	66.4	11.5	69.9	--	121.5	155.8	102.8	119.8
	369507		L	A	76.8	71.0	11.5	72.4	--	125.1	161.6	105.7	122.4
			T		77.2	69.4	12.0	74.4	--	124.6	160.0	107.6	125.0
	369508		L	A	79.8	73.6	11.5	74.5	--	127.2	163.3	106.2	122.4
			T		79.2	71.6	12.0	77.8	--	127.5	161.8	111.4	127.6
	369619		L	A	79.4	73.8	11.5	74.6	--	128.8	165.0	110.4	125.2
			T		79.6	71.5	12.5	77.2	--	128.3	164.8	110.2	130.1
	369545	0.125	L	A	77.1	72.6	12.5	72.5	--	123.8	158.9	104.1	120.2
			T		77.4	68.6	12.5	75.0	--	123.0	159.6	106.8	125.0
	369546		L	A	76.3	69.1	12.2	69.2	--	123.2	158.0	103.4	120.4
			T		77.6	66.9	12.0	72.9	--	122.9	158.2	103.3	121.8
	369457	0.188	L	A	79.0	73.3	12.5	72.2	--	127.7	163.0	109.9	127.0
			T		79.6	71.6	12.5	74.8	--	127.4	162.8	109.2	127.6
	369493	0.249	L	A	75.7	69.6	13.5	69.3	--	122.5	156.2	103.4	121.6
			T		76.1	67.8	13.5	72.0	--	121.8	158.8	102.9	126.0
-T761	369611	0.063	L	A	71.0	62.0	10.5	61.4	43.2#	114.4	147.6	92.8	107.2
			T		71.0	60.5	10.5	65.4	--	115.3	147.4	94.2	109.8
	369612		L	A	75.6	66.8	10.3	66.7	45.9#	123.2	159.1	99.7	118.6
			T		74.6	64.9	10.0	69.9	--	122.4	159.2	100.8	117.1
	369458	0.090	L	A	71.1	61.4	11.5	59.4	--	111.0	142.6	92.7	106.8
			T		69.6	59.4	11.2	62.2	--	110.0	141.6	91.4	107.4
	369614		L	A	74.4	66.5	11.8	68.5	--	120.6	153.6	100.2	117.1
			T		75.2	65.6	12.0	71.2	--	120.2	155.2	100.6	119.7
	369460	0.188	L	A	72.0	64.1	13.0	62.8	--	114.0	146.0	94.7	113.4
			T		72.5	62.9	13.5	64.6	--	114.8	147.9	95.2	114.3
	369499	0.249	L	A	69.4	60.9	14.0	59.4	--	110.8	142.0	90.6	111.1
			T		71.5	61.9	13.8	62.6	--	111.1	142.7	92.6	111.2

* Offset equals 0.2 per cent.
† Offset equals 2.0 per cent of pin diameter.
‡ L-Longitudinal; T-Transverse
\# Punch-type shear specimens, all others cylindrical.
‡‡ Specimens and fixtures cleaned ultrasonically.

TABLE XII

MECHANICAL PROPERTIES OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample				Tensile				Compressive	Shear	Bearing‡‡ Flatwise			
										Ultimate Strength, ksi		Yield Strength,† ksi	
Number	Thickness, in.	Direction‡	Producer	Ultimate Strength, ksi	Yield Strength,* ksi	Elong. in 2 in. or 4D, %	Reduction of Area, %	Yield Strength,* ksi	Ultimate Strength, ksi	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410675	1.750	L	A	72.0	67.0	10.0	25	66.7	41.9	107.5	139.5	94.8	109.8
		LT		71.5	65.7	8.0	18	67.0	42.1	107.2	139.1	94.1	108.8
		ST		70.4	65.3	3.1	8	68.0	39.8	--	--	--	--
410680	2.000	L	C	71.5	66.2	9.5	25	65.2	41.2	108.1	139.1	95.5	107.2
		LT		71.1	65.4	8.0	15	66.7	41.2	107.4	138.1	95.5	109.0
		ST		68.2	64.9	3.1	9	68.0	39.1	--	--	--	--
410681	2.040	L	B	70.8	65.4	8.5	22	63.4	41.2	105.7	138.3	92.0	105.8
		LT		70.9	65.2	7.0	26	65.7	41.2	105.4	136.3	92.8	106.4
		ST		68.2	62.7	4.7	8	66.2	39.6	--	--	--	--
410676	2.500	L	A	71.5	65.4	9.0	22	63.9	40.9	106.4	138.3	93.0	108.7
		LT		70.7	64.2	7.0	14	66.0	41.0	106.6	137.0	92.1	105.1
		ST		69.2	63.5	3.0	6	66.7	39.6	--	--	--	--
410677	3.500	L	A	70.3	63.9	9.0	21	62.9	40.7	104.9	136.2	91.3	107.1
		LT		69.9	62.7	7.0	13	63.7	40.7	105.5	135.4	92.0	104.6
		ST		68.5	61.4	4.0	6	64.9	39.1	--	--	--	--
410682	4.000	L	B	70.2	65.5	6.5	10	63.1	40.7	103.7	133.8	94.5	106.3
		LT		69.7	64.2	5.5	11	64.2	40.7	103.4	135.6	91.8	106.3
		ST		65.9	60.2	4.0	6	65.7	38.7	--	--	--	--
410678	4.500	L	A	70.2	63.4	8.0	19	61.1	40.5	103.8	135.0	93.3	107.1
		LT		69.4	61.4	6.0	11	62.9	40.5	105.4	135.7	93.0	105.8
		ST		65.6	59.8	3.0	3	64.2	38.9	--	--	--	--
410683	4.500	L	C	67.8	59.8	8.0	13	57.3	39.1	100.9	131.2	85.2	98.4
		LT		67.5	58.5	8.0	11	58.1	39.3	100.9	130.4	86.4	97.8
		ST		64.1	57.3	2.5	5	62.4	36.8	--	--	--	--
410679	5.500	L	A	68.2	61.1	8.0	16	58.3	40.0	101.7	131.5	90.3	103.7
		LT		67.5	59.3	7.0	10	60.1	40.0	102.5	132.0	88.6	105.1
		ST		63.6	57.5	2.5	4	61.6	38.4	--	--	--	--
410684	6.000	L	C	65.2	57.1	8.0	18	52.1	38.2	96.5	125.3	83.8	97.0
		LT		64.6	55.0	7.0	9	56.0	38.0	97.4	126.5	84.1	94.1
		ST		60.6	54.8	3.5	2	58.5	36.4	--	--	--	--

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡‡ Specimens and fixtures cleaned ultrasonically.
‡ L-Longitudinal; LT-Long Transverse; ST-Short Transverse; L & LT specimens taken from T/4 location; ST specimens taken from T/2 location.

TABLE XIII

SUPPLEMENTAL MECHANICAL PROPERTIES OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Location	Direction‡	Tensile Ultimate Strength, ksi	Tensile Yield Strength,* ksi	Tensile Elong in 2 in. or 4D, %	Tensile Reduction of Area, %	Compressive Yield Strength,* ksi	Shear Ultimate Strength, ksi	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=1.5	Bearing‡‡ Flatwise Ultimate Strength, ksi e/D=2.0	Bearing‡‡ Flatwise Yield Strength,† ksi e/D=1.5	Bearing‡‡ Flatwise Yield Strength,† ksi e/D=2.0
369734-3	1.500	T/2	L	69.3	62.8	10.5	28	66.5	39.2	--	--	--	--
			LT	71.0	65.8	9.5	22	64.6	39.1	--	--	--	--
			ST	67.4	64.0	2.4	6	69.0	37.9	--	--	--	--
369736-3			L	69.6	63.5	10.2	26	65.0	39.6	101.9	132.9	89.1	102.1
			LT	70.2	64.4	9.0	20	64.6	39.6	100.8	131.2	88.4	102.7
			ST	67.0	62.8	3.1	2	67.6	37.2	--	--	--	--
369738-3			L	71.6	66.7	9.5	25	66.7	41.2	104.0	135.6	90.7	106.4
			LT	71.6	66.0	8.5	20	66.7	40.2	104.2	135.1	92.3	105.0
			ST	68.5	64.2	4.7	2	69.0	37.8	--	--	--	--
369797-3			L	72.8	66.6	10.8	28	68.0	40.0	102.0	135.0	91.3	107.0
			LT	73.0	67.0	9.5	23	67.2	40.4	104.0	135.0	91.3	107.0
			ST	70.9	65.4	4.7	2	70.8	37.7	--	--	--	--
337676	3.560	T/4	L	68.4	62.6	8.0	23	61.2	40.6	--	--	--	--
			LT	68.1	61.3	8.0	12	62.0	40.7	--	--	--	--
		T/2	ST	65.3	59.8	3.0	2	63.8	38.9	--	--	--	--
342615-1	4.000	T/4	L	68.0	62.3	10.0	25	61.6	39.9	96.3	125.1	86.8	102.7
			LT	67.2	62.0	7.5	13	62.4	39.2	102.8	131.9	89.5	105.8
		T/2	ST	63.6	59.3	2.3	6	62.6	35.4	--	--	--	--
342713-1		T/4	L	69.2	63.6	8.3	19	63.0	40.0	100.2	129.6	88.3	103.6
			LT	68.2	61.9	6.8	12	63.9	39.9	98.8	128.6	89.7	105.2
		T/2	ST	64.9	59.9	3.0	4	63.8	37.1	--	--	--	--
340897	4.310	T/4	L	66.6	59.1	8.5	18	58.2	39.4	--	--	--	--
			LT	66.4	58.2	8.0	16	58.4	39.6	--	--	--	--
		T/2	ST	63.9	57.5	4.5	4	60.8	38.4	--	--	--	--
337664	5.560	T/4	L	64.8	57.4	9.0	21	54.3	38.4	--	--	--	--
			LT	64.6	55.4	7.5	12	56.4	38.6	--	--	--	--
		T/2	ST	61.2	55.3	3.5	2	58.6	37.4	--	--	--	--

* Offset equals 0.2 per cent.
† Offset equals 2 per cent of pin diameter.
‡ L-Longitudinal; LT-Long-Transverse; ST-Short-Transverse.
‡‡ Specimens and fixtures cleaned ultrasonically.

TABLE XIV

SPECIFIED MINIMUM TENSILE PROPERTY VALUES FOR SOME ALUMINUM ALLOY FORGINGS, SHEET AND PLATE

(F33615-71-C-1571)

Alloy and Temper	Product	Thickness, in.	Longitudinal			Long-Transverse			Short-Transverse			Specification
			Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 2 in. or 4D, %	Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 2 in. or 4D, %	Ultimate Strength, ksi	Yield Strength,* ksi	Elong in 2 in. or 4D, %	
7049-T73	Hand Forging	≤ 2.000	--	--	--	--	--	--	--	--	--	None
		2.001-3.000	71.0	61.0	9	71.0	59.0	4	69.0	58.0	3	AMS 4111
		3.001-4.000	69.0	59.0	8	69.0	57.0	3	67.0	56.0	2	
		4.001-5.000	67.0	56.0	7	67.0	56.0	3	66.0	55.0	2	
	Die Forging	≤ 1.000	72.0	62.0	7	--	--	--	71.0	61.0	3	AMS 4111
		1.001-2.000	72.0	62.0	7	--	--	--	70.0	60.0	3	
		2.001-3.000	71.0	61.0	7	--	--	--	70.0	60.0	3	
		4.001-5.000	70.0	60.0	7	--	--	--	68.0	58.0	2	
7175-T736	Hand Forging	≤ 3.000	73.0	63.0	9	71.0	60.0	5	69.0	60.0	4	Tentative
		3.001-4.000	71.0	61.0	9	70.0	58.0	5	68.0	57.0	4	
		4.001-5.000	68.0	57.0	8	67.0	56.0	5	66.0	55.0	4	
	Die Forging	≤ 3.000	76.0	66.0	7	--	--	--	71.0	62.0	4	AMS 4149
7475-T61	Sheet	0.040-0.249	--	--	--	75.0	64.0	9	--	--	--	Tentative
7475-T761	Sheet	0.032	--	--	--	--	--	--	--	--	--	None
		0.040-0.249	--	--	--	71.0	60.0	9	--	--	--	Tentative
Alc.7475-T61	Sheet	0.040-0.062	--	--	--	69.0	59.0	9	--	--	--	Tentative
		0.063-0.187	--	--	--	70.0	60.0	9	--	--	--	
		0.188-0.249	--	--	--	72.0	61.0	9	--	--	--	
Alc.7475-T761	Sheet	0.040-0.062	--	--	--	66.0	55.0	9	--	--	--	Tentative
		0.063-0.187	--	--	--	67.0	56.0	9	--	--	--	
		0.188-0.249	--	--	--	69.0	57.0	9	--	--	--	
2124-T851	Plate	1.500-2.000	66.0	57.0	6	66.0	57.0	5	64.0	55.0	1.5	Interim Federal Specification QQ-A-00250/29
		2.001-3.000	65.0	57.0	6	65.0	57.0	4	63.0	55.0	1.5	
		3.001-4.000	65.0	56.0	5	65.0	56.0	4	62.0	54.0	1.5	
		4.001-5.000	64.0	55.0	5	64.0	55.0	4	61.0	53.0	1.5	
		5.001-6.000	63.0	54.0	5	63.0	54.0	4	59.0	51.0	1.5	

* Offset equals 0.2 per cent.

TABLE XV

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF 7049-T73 DIE FORGINGS

(F33615-71-C-1571)

Sample		Die	Producer	Compressive		Shear		Bearing (Edgewise)			
								BUS(L)/TUS(L)		BYS(L)/TYS(L)	
Number	Thickness Range, in.	No.		CYS(L)/TYS(L)	CYS(ST)/TYS(ST)	SU(L)/TUS(L)	SU(ST)/TUS(L)	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410693	1.000	9078	A	1.01	1.06	0.55	0.54	1.41	1.82	1.24	1.53
410698	1.001-2.000	15789	A	1.07	1.08	0.65	0.61	1.47	2.00	1.37	1.61
410694		B5786	B	1.03	1.03	0.62	0.62	1.41	2.01	1.25	1.61
410697A		40005	A	1.12	1.05	0.59	0.56	1.51	1.95	1.36	1.63
410697C		40005	A	1.06	1.04	0.54	--	--	--	--	--
410695	2.001-3.000	40006	A	1.02	1.03	0.56	0.56	1.41	1.83	1.30	1.55
410696		B6204	B	1.10	1.03	0.63	0.61	1.65	1.96	1.60	1.74
410697B		40005	A	1.05	1.06	0.55	0.54	1.46	1.97	1.29	1.49
410700	4.001-5.000	B2362	B	1.07	1.04	0.59	0.58	1.45	1.81	1.48	1.73

TABLE XVI

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Sample				Compressive		Shear		Bearing (Edgewise)			
								BUS(L)/TUS(L)		BYS(L)/TYS(L)	
Number	Thickness Range, in.	Die No.	Producer	CYS(L)/TYS(L)	CYS(ST)/TYS(ST)	SU(L)/TUS(L)	SU(ST)/TUS(L)	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410983	≤1.000	9078	A	1.03	1.07	0.58	0.56	1.46	1.85	1.36	1.52
410699	1.001-2.000	15789	A	1.01	1.06	0.58	0.60	1.44	1.89	1.29	1.69
410704		F17961	A	1.03	1.06	0.57	0.56	1.46	1.91	1.32	1.55
410705A		40005	A	1.11	1.06	0.60	0.58	1.51	2.01	1.39	1.67
410705C		40005	A	1.04	1.05	0.56	--	--	--	--	--
410706		F17976	A	1.03	1.05	0.58	0.58	1.25	1.86	1.27	1.60
410705B	2.001-3.000	40005	A	1.06	1.03	0.58	0.57	1.50	1.93	1.39	1.61
410984		40006	A	1.01	1.05	0.59	0.57	1.43	1.83	1.33	1.52

TABLE XVII

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF 7049-T73 HAND FORGINGS

(F33615-71-C-1571)

Sample			Compressive			Shear			Bearing (Edgewise)							
									BUS(L)/TUS(LT)		BYS(L)/TYS(LT)		BUS(LT)/TUS(LT)		BYS(LT)/TYS(LT)	
Number	Dimensions, in.	Producer	CYS(L)/TYS(L)	CYS(LT)/TYS(LT)	CYS(ST)/TYS(ST)	SU(L)/TUS(LT)	SU(LT)/TUS(LT)	SU(ST)/TUS(LT)	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
411019	2x16	A	1.10	1.05	1.15	0.60	0.61	0.58	1.37	1.78	1.42	1.61	1.42	1.83	1.50	1.69
410686	3x16	A	1.02	1.01	1.05	0.60	0.56	0.57	1.57	2.03	1.53	1.79	1.42	1.85	1.33	1.60
410966	4x16	A	0.91	1.02	1.09	0.59	0.57	0.58	1.42	1.96	1.34	1.70	1.47	1.91	1.44	1.73
410688	5x20	A	1.04	1.07	1.04	0.62	0.60	0.66	1.43	2.04	1.48	1.85	1.47	1.85	1.49	1.82

TABLE XVIII

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Sample			Compressive			Shear			Bearing (Edgewise)							
									BUS(L)/TUS(LT)		BYS(L)/TYS(LT)		BUS(LT)/TUS(LT)		BYS(LT)/TYS(LT)	
Number	Dimensions,	Producer	CYS(L)/TYS(L)	CYS(LT)/TYS(LT)	CYS(ST)/TYS(ST)	SU(L)/TUS(LT)	SU(LT)/TUS(LT)	SU(ST)/TUS(LT)	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0	e/D=1.5	e/D=2.0
410689	2x16	A	1.04	1.07	1.04	0.62	0.56	0.62	1.58	2.03	1.52	1.75	1.43	1.99	1.48	1.68
410985	3x12	A	0.97	1.06	1.07	0.65	0.64	0.60	1.48	1.98	1.48	1.72	1.51	1.93	1.43	1.63
410691	4x16	A	1.08	1.08	1.04	0.60	0.58	0.58	1.62	1.90	1.63	1.74	1.48	1.92	1.42	1.74
410986	5x20	A	1.01	1.06	1.09	0.62	0.62	0.58	1.38	1.86	1.38	1.64	1.52	1.92	1.47	1.71

TABLE XIX

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF BARE AND ALCLAD 7475-T61 SHEET

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Thickness, in.	Producer	Tensile TUS(L)/TUS(LT)	Tensile TYS(L)/TYS(LT)	Compressive CYS(L)/TYS(LT)	Compressive CYS(LT)/TYS(LT)	Shear SU/TUS(LT)	Shear SU(L)/TUS(LT)	Shear SU(LT)/TUS(LT)	Bearing (Flatwise) BUS(L)/TUS(LT) e/D=1.5	BUS(L)/TUS(LT) e/D=2.0	BYS(L)/TYS(LT) e/D=1.5	BYS(L)/TYS(LT) e/D=2.0	BUS(LT)/TUS(LT) e/D=1.5	BUS(LT)/TUS(LT) e/D=2.0	BYS(LT)/TYS(LT) e/D=1.5	BYS(LT)/TYS(LT) e/D=2.0
7475-T61	410651	0.040	A	1.00	1.05	0.98	1.05	0.61	--	--	1.56	1.96	1.36	1.64	1.54	2.02	1.38	1.59
	410652		A	1.04	1.07	1.01	1.05	0.63	--	--	1.61	2.17	1.43	1.58	1.61	2.10	1.43	1.64
	369704	0.063	A	1.02	1.06	1.04	1.11	0.62	--	--	--	--	--	--	--	--	--	--
	410653		A	0.99	1.02	1.03	1.07	0.60	--	--	1.64	2.08	1.47	1.61	1.64	2.07	1.47	1.69
	410654		A	1.00	1.03	0.97	1.06	0.59	--	--	1.61	2.01	1.40	1.61	1.61	2.01	1.43	1.63
	369544	0.090	A	1.01	1.05	1.04	1.08	--	--	--	1.64	2.10	1.55	1.75	1.63	2.08	1.55	1.76
	369621		A	1.00	1.05	1.02	1.07	--	--	--	1.61	2.07	1.53	1.74	1.61	2.07	1.51	1.78
	369598		A	1.00	1.02	1.04	1.08	--	--	--	1.63	2.09	1.53	1.70	1.63	2.08	1.54	1.68
	369618		A	1.00	1.02	1.02	1.08	--	--	--	1.62	2.07	1.54	1.73	1.62	2.07	1.52	1.75
	410655		A	1.00	1.03	1.01	1.06	--	--	--	1.60	2.06	1.51	1.67	1.60	2.05	1.53	1.70
	410656		A	1.00	1.03	1.02	1.06	--	--	--	1.60	2.05	1.51	1.70	1.61	2.07	1.54	1.74
	369597	0.125	A	0.99	1.02	1.02	1.06	--	--	--	1.61	2.07	1.48	1.72	1.61	2.07	1.50	1.75
	369543		A	1.00	1.07	1.06	1.09	--	--	--	1.62	2.08	1.56	1.80	1.64	2.07	1.60	1.86
	410657		A	0.99	1.03	1.03	1.06	--	--	--	1.64	2.05	1.58	1.78	1.64	2.04	1.55	1.78
	410658		A	1.00	1.05	1.04	1.07	--	--	--	1.64	2.04	1.55	1.79	1.63	2.03	1.59	1.81
	369548	0.188	A	0.98	1.04	1.02	1.06	--	--	--	1.62	2.07	1.56	1.74	1.62	2.08	1.57	1.84
	369596		A	1.00	1.04	1.03	1.06	--	--	--	1.65	2.11	1.57	1.78	1.64	2.10	1.58	1.84
	410659		A	1.01	1.04	0.99	1.06	--	--	--	1.62	2.07	1.51	1.72	1.60	2.06	1.51	1.75
	410660		A	1.00	1.04	1.01	1.07	--	0.66	0.65	1.62	2.09	1.52	1.76	1.61	2.08	1.53	1.75
	369516	0.249	A	0.99	1.03	1.00	1.06	--	0.64	0.65	1.62	2.06	1.54	1.79	1.61	2.07	1.53	1.76
	369517		A	1.00	1.02	1.01	1.05	--	0.65	0.64	1.63	2.09	1.53	1.79	1.63	2.09	1.52	1.82
	410661		A	0.98	1.03	1.05	1.05	--	0.64	0.63	1.58	2.04	1.49	1.69	1.58	2.03	1.50	1.74
	410662		A	0.99	1.03	1.01	1.07	--	0.64	0.64	1.58	2.02	1.50	1.77	1.58	1.99	1.49	1.76
Alc7475-T61	369505	0.040	A	1.00	1.01	1.04	1.05	0.64	--	--	1.70	2.04	1.59	1.77	1.65	1.89	1.51	1.69
	369506		A	1.07	1.08	1.03	1.07	0.65	--	--	1.63	1.97	1.48	1.77	1.74	1.86	1.51	1.70
	369594	0.063	A	1.02	1.04	1.03	1.07	0.61	--	--	1.63	2.12	1.45	1.69	1.65	2.12	1.49	1.66
	369616		A	1.01	1.04	1.03	1.07	0.61	--	--	1.65	2.13	1.50	1.73	1.66	2.15	1.50	1.77
	369620		A	1.02	1.04	1.01	1.07	0.62	--	--	1.67	2.15	1.50	1.73	1.67	2.14	1.52	1.75
	369617		A	1.02	1.05	1.04	1.09	0.62	--	--	1.69	2.19	1.51	1.79	1.69	2.20	1.56	1.85
	369456	0.090	A	1.04	1.04	1.00	1.05	--	--	--	1.60	2.08	1.51	1.80	1.62	2.07	1.55	1.80
	369507		A	0.99	1.02	1.04	1.07	--	--	--	1.62	2.09	1.52	1.76	1.61	2.07	1.55	1.80
	369508		A	1.01	1.03	1.04	1.09	--	--	--	1.61	2.06	1.48	1.71	1.61	2.04	1.56	1.78
	369619		A	1.00	1.03	1.04	1.08	--	--	--	1.62	2.07	1.54	1.75	1.61	2.07	1.54	1.82
	369145	0.125	A	1.00	1.06	1.06	1.09	--	--	--	1.60	2.05	1.52	1.75	1.59	2.06	1.56	1.82
	369546		A	0.98	1.03	1.03	1.09	--	--	--	1.59	2.04	1.55	1.80	1.58	2.04	1.54	1.82
	369547	0.188	A	0.99	1.02	1.01	1.04	--	--	--	1.60	2.05	1.53	1.77	1.60	2.05	1.53	1.78
	369493	0.249	A	0.99	1.03	1.02	1.06	--	--	--	1.61	2.05	1.53	1.79	1.60	2.09	1.52	1.86

TABLE XX

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF BARE AND ALCLAD 7475-T761 SHEET

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Thickness, in.	Producer	Tensile TUS(L)/TUS(LT)	Tensile TYS(L)/TYS(LT)	Compressive CYS(L)/TYS(L)	Compressive CYS(LT)/TYS(LT)	Shear SU/TUS(LT)	Shear SUS(L)/TUS(LT)	Shear SUS(LT)/TUS(LT)	Bearing (Flatwise) BUS(L)/TUS(LT) e/D=1.5	BUS(L)/TUS(LT) e/D=2.0	BYS(L)/TUS(LT) e/D=1.5	BYS(L)/TUS(LT) e/D=2.0	BUS(LT)/TUS(LT) e/D=1.5	BUS(LT)/TUS(LT) e/D=2.0	BYS(LT)/TUS(LT) e/D=1.5	BYS(LT)/TUS(LT) e/D=2.0
7475-T761	410888	0.032	A	1.02	1.05	1.03	1.05	0.62	--	--	1.50	2.08	1.33	1.61	1.60	2.05	1.43	1.64
	410663	0.040	A	1.02	1.04	1.00	1.04	0.62	--	--	1.53	1.98	1.37	1.54	1.55	2.05	1.39	1.65
	410664		A	1.03	1.05	1.00	1.03	0.62	--	--	1.62	2.11	1.33	1.67	1.59	2.16	1.39	1.58
	369705	0.063	A	1.03	1.03	1.01	1.03	0.61	--	--	--	--	--	--	--	--	--	--
	410665		A	1.03	1.02	1.06	1.08	0.63	--	--	1.62	2.03	1.43	1.67	1.63	2.05	1.45	1.69
	410666		A	1.00	1.02	1.01	1.05	0.60	--	--	1.60	2.06	1.48	1.74	1.61	2.06	1.52	1.79
	369615	0.090	A	0.99	1.02	1.02	1.08	--	--	--	1.60	2.03	1.56	1.75	1.57	2.02	1.49	1.77
	369613		A	1.01	1.03	1.04	1.08	--	--	--	1.61	2.07	1.53	1.76	1.60	2.05	1.53	1.76
	410667		A	1.01	1.04	1.01	1.05	--	--	--	1.61	2.08	1.54	1.72	1.60	2.05	1.54	1.72
	410668		A	1.00	1.02	1.01	1.07	--	--	--	1.61	2.07	1.54	1.69	1.59	2.04	1.31	1.67
	369599	0.125	A	0.99	1.02	1.00	1.06	--	--	--	1.60	2.05	1.52	1.77	1.60	2.05	1.55	1.81
	369542		A	1.00	1.04	1.05	1.07	--	--	--	1.61	2.07	1.52	1.77	1.61	2.08	1.53	1.82
	410669		A	0.99	1.02	1.00	1.07	--	--	--	1.62	2.03	1.59	1.83	1.58	2.01	1.56	1.82
	410670		A	0.98	1.02	1.00	1.06	--	--	--	1.60	2.02	1.56	1.78	1.61	2.01	1.59	1.84
	410671	0.188	A	0.99	1.02	0.97	1.04	--	0.64	0.63	1.60	2.03	1.52	1.76	1.58	2.01	1.52	1.76
	410672		A	1.01	1.03	0.99	1.03	--	0.65	0.63	1.59	2.03	1.50	1.76	1.59	2.01	1.51	1.74
	369509	0.249	A	1.00	1.03	0.98	1.05	--	0.65	0.64	1.58	2.05	1.53	1.80	1.60	2.05	1.56	1.86
	369510		A	1.00	1.02	1.01	1.04	--	0.65	0.65	1.62	2.08	1.51	1.76	1.60	2.07	1.48	1.79
	410673		A	0.99	1.02	0.97	1.04	--	0.64	0.64	1.57	1.99	1.51	1.73	1.56	2.00	1.48	1.77
	410674		A	0.98	0.99	0.97	1.05	--	0.64	0.64	1.56	1.99	1.48	1.73	1.55	1.98	1.47	1.77
Alc7475-T761	369611	0.063	A	1.00	1.02	1.01	1.08	0.61	--	--	1.61	2.08	1.53	1.77	1.62	2.08	1.56	1.81
	369612		A	1.01	1.03	1.03	1.08	0.62	--	--	1.65	2.13	1.54	1.83	1.64	2.13	1.55	1.80
	369458	0.090	A	1.02	1.03	1.00	1.05	--	--	--	1.59	2.05	1.56	1.80	1.58	2.03	1.54	1.81
	369614		A	0.99	1.01	1.04	1.09	--	--	--	1.60	2.04	1.53	1.79	1.60	2.06	1.53	1.82
	369460	0.188	A	0.99	1.02	1.00	1.03	--	--	--	1.57	2.01	1.51	1.80	1.58	2.04	1.51	1.82
	369499	0.249	A	0.97	0.98	0.96	1.01	--	--	--	1.55	1.99	1.46	1.79	1.55	2.00	1.50	1.80

TABLE XXI

RATIOS AMONG THE TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample			Compressive			Shear			Bearing (Flatwise)							
Number	Thickness, in.	Producer	CYS(L)/TYS(L)	CYS(LT)/TYS(LT)	CYS(ST)/TYS(ST)	SU(L)/TUS(LT)	SU(LT)/TUS(LT)	SU(ST)/TUS(LT)	BUS(L)/TUS(LT) e/D=1.5	BUS(L)/TUS(LT) e/D=2.0	BYS(L)/TYS(LT) e/D=1.5	BYS(L)/TYS(LT) e/D=2.0	BUS(LT)/TUS(LT) e/D=1.5	BUS(LT)/TUS(LT) e/D=2.0	BYS(LT)/TYS(LT) e/D=1.5	BYS(LT)/TYS(LT) e/D=2.0
369734-3	1.500	A	1.06	0.98	1.08	0.55	0.55	0.53	--	--	--	--	--	--	--	--
369736-3		A	1.02	1.00	1.08	0.56	0.56	0.53	1.45	1.89	1.38	1.59	1.44	1.87	1.37	1.59
369738-3		A	1.00	1.01	1.07	0.58	0.56	0.53	1.45	1.89	1.37	1.61	1.46	1.89	1.40	1.59
369737-3		A	1.02	1.03	1.08	0.55	0.55	0.52	1.40	1.85	1.36	1.60	1.42	1.85	1.36	1.60
410675	1.750	A	1.00	1.02	1.04	0.59	0.59	0.56	1.50	1.95	1.44	1.67	1.50	1.95	1.43	1.66
410680	2.000	C	0.98	1.02	1.05	0.58	0.58	0.55	1.52	1.96	1.46	1.64	1.51	1.94	1.46	1.67
410681	2.040	B	0.98	1.01	1.06	0.58	0.58	0.56	1.49	1.95	1.41	1.62	1.49	1.92	1.42	1.63
410676	2.500	A	0.98	1.03	1.05	0.58	0.58	0.56	1.50	1.96	1.45	1.69	1.51	1.94	1.43	1.64
410677	3.500	A	0.98	1.02	1.06	0.58	0.58	0.56	1.50	1.95	1.46	1.71	1.51	1.94	1.47	1.67
337676	3.560	A	0.98	1.01	1.07	0.60	0.60	0.57	--	--	--	--	--	--	--	--
410682	4.000	B	0.96	1.00	1.09	0.58	0.58	0.56	1.49	1.92	1.47	1.66	1.48	1.95	1.43	1.66
342615-1		A	0.99	1.01	1.06	0.59	0.58	0.53	1.43	1.86	1.40	1.66	1.53	1.96	1.44	1.71
342713-1		A	0.99	1.03	1.07	0.59	0.59	0.54	1.47	1.90	1.43	1.68	1.45	1.89	1.45	1.70
340897	4.310	A	0.98	1.00	1.06	0.59	0.60	0.58	--	--	--	--	--	--	--	--
410678	4.500	A	0.96	1.02	1.07	0.58	0.58	0.56	1.50	1.95	1.52	1.74	1.52	1.96	1.51	1.72
410683		C	0.96	0.99	1.09	0.58	0.58	0.55	1.49	1.94	1.46	1.68	1.49	1.93	1.48	1.67
410675	5.500	A	0.95	1.01	1.07	0.59	0.59	0.57	1.51	1.95	1.52	1.75	1.52	1.96	1.49	1.77
337664	5.560	A	0.95	1.02	1.06	0.59	0.60	0.58	--	--	--	--	--	--	--	--
410684	6.000	C	0.91	1.02	1.07	0.59	0.59	0.56	1.49	1.94	1.52	1.76	1.51	1.96	1.53	1.71

TABLE XXII

STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGEWISE BEARING PROPERTIES OF 7049-T73 DIE FORGINGS

(F33615-71-C-1571)

							e/D=1.5				e/D=2.0			
Ratio Cell	CYS(L)/TYS(L)	CYS(ST)/TYS(ST)	Ratio Cell	SUS(L)/TUS(L)	SUS(ST)/TUS(L)	SUS(L,ST)/TUS(L)*	Ratio Cell	BUS(L)/TUS(L)	Ratio Cell	BYS(L)/TYS(L)	Ratio Cell	BUS(L)/TUS(L)	Ratio Cell	BYS(L)/TYS(L)
1.12	1		0.65	1		1	1.65	1	1.60	1	2.01	1	1.74	1
1.11			0.64								2.00	1	1.73	1
1.10	1		0.63	1		1	1.51	1	1.48	1	1.99			
1.09			0.62	1	1	2	1.50				1.98			
1.08		1	0.61		2	2	1.49		1.37	1	1.97	1	1.63	1
1.07	2		0.60				1.48		1.36	1	1.96	1	1.62	
1.06	1	2	0.59	2		2	1.47	1	1.35		1.95	1	1.61	2
1.05	1	1	0.58		1	1	1.46	1	1.34					
1.04		2	0.57				1.45	1	1.33		1.83	1		
1.03	1	3	0.56	1	2	3	1.44		1.32		1.82	1	1.55	1
1.02	1		0.55	2		2	1.43		1.31		1.81	1	1.54	
1.01	1		0.54	1	2	3	1.42		1.30	1			1.53	1
							1.41	3	1.29	1			1.52	
									1.28				1.51	
									1.27				1.50	
									1.26				1.49	1
									1.25	1				
									1.24	1				
n	9	9		9	8	17		8		8		8		8
$\bar{R}$	1.059	1.047		0.587	0.578	0.582		1.471		1.361		1.919		1.611
$\sigma_{\bar{R}}$	.03621	.01732				.03562		.08043		.12369		.08425		.08951
Min $\bar{R}$	1.036	1.036				0.567		1.417		1.278		1.862		1.551

* Students "t"-test showed no significant difference between average ratios for L and ST directions and "f"-test showed no significant difference in variability for L and ST directions.

TABLE XXIII

STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGEWISE BEARING PROPERTIES OF 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Ratio Cell	CYS(L)/TYS(L)	CYS(ST)/TYS(ST)
1.11	1	
1.10		
1.09		
1.08		
1.07		1
1.06	1	3
1.05		3
1.04	1	
1.03	3	1
1.02		
1.01	2	
n	8	8
$\bar{R}$	1.040	1.054
$\sigma_{\bar{R}}$	.03251	.00420**
Min $\bar{R}$	1.018	1.055-1.024

Ratio Cell	SUS(L)/TUS(L)	SUS(ST)/TUS(ST)	SUS(L&ST)*/TUS(ST)
0.60	1	1	2
0.59	1		1
0.58	4	2	6
0.57	1	2	3
0.56	1	2	3
n	8	7	15
$\bar{R}$	0.580	0.574	0.577
$\sigma_{\bar{R}}$			.01280
Min $\bar{R}$			0.572

e/D=1.5: Ratio Cell	BUS(L)/TUS(L)	Ratio Cell	BYS(L)/TYS(L)
1.51	1	1.39	2
1.50	1	1.38	
1.49		1.37	
1.48		1.36	1
1.47		1.35	1
1.46	2	1.34	
1.45		1.33	1
1.44	1	1.32	1
1.43	1	1.31	
		1.30	
1.37	1	1.29	1
n	7		7
$\bar{R}$	1.453		1.347
$\sigma_{\bar{R}}$	.04680		.03684
Min $\bar{R}$	1.418		1.320

e/D=2.0: Ratio Cell	BUS(L)/TUS(L)	Ratio Cell	BYS(L)/TYS(L)
2.01	1	1.69	1
2.00		1.68	
1.99		1.67	1
1.98		1.66	
1.97		1.65	
1.96		1.64	
1.95		1.63	
1.94		1.62	
1.93	1	1.61	1
1.92		1.60	1
1.91	1	1.59	
1.90		1.58	
1.89	1	1.57	
1.88		1.56	
1.87		1.55	1
1.86	1	1.54	
1.85	1	1.53	
1.84		1.52	2
1.83	1		
n	7		7
$\bar{R}$	1.897		1.594
$\sigma_{\bar{R}}$	.06075		.06852
Min $\bar{R}$	1.853		1.544

* Students "t"-test showed no significant difference between average ratios for L and ST directions and "f"-test showed no significant difference in variability for L and ST directions.

** Regression analysis showed significant relationship with thickness. Value shown is $\sigma_e/\sqrt{n}$.

TABLE XXIV

STATISTICAL ANALYSIS OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGEWISE BEARING PROPERTIES OF 7049-T73 HAND FORGINGS

(F33615-71-C-1571)

Ratio Cell	CYS(L)/TYS(L)	CYS(LT)/TYS(LT)	CYS(ST)/TYS(ST)
1.15			1
1.14			
1.13			
1.12			
1.11			
1.10	1		
1.09			1
1.08			
1.07		1	
1.06			
1.05		1	1
1.04	1		1
1.03			
1.02	1	1	
1.01		1	
1.00			
0.91	1		
n	4	4	4
$\bar{R}$	1.018	1.038	1.082
$\sigma_{\bar{R}}$	.07932	.02754	.04992
Min $\bar{R}$	[illegible].006	[illegible].026	[illegible].072

Ratio Cell	SUS(L)/TUS(LT)	SUS(LT)/TUS(LT)	SUS(ST)/TUS(LT)	SUS(L&LT)*/TUS(LT)	SUS(LT&ST)*/TUS(LT)
0.66			1		1
0.65					
0.64					
0.63					
0.62	1			1	
0.61		1		1	1
0.60	2	1		3	1
0.59	1			1	
0.58			2		2
0.57		1	1	1	2
0.56		1		1	1
n	4	4	4	8	8
$\bar{R}$	0.602	0.585	0.598	0.594	0.591
$\sigma_{\bar{R}}$				.01996	.03227
Min $\bar{R}$				0.580	0.570

e/D=1.5

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)*/TUS(LT)
1.57	1		1
1.56			
1.55			
1.54			
1.53			
1.52			
1.51			
1.50			
1.49			
1.48			
1.47		2	2
1.46			
1.45			
1.44			
1.43	1		1
1.42	1	2	3
1.41			
1.40			
1.39			
1.38			
1.37	1		1
n	4	4	8
$\bar{R}$	1.448	1.445	1.446
$\sigma_{\bar{R}}$			.05927
Min $\bar{R}$			1.407

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
1.53	1		1
1.52			
1.51			
1.50		1	1
1.49		1	1
1.48	1		1
1.47			
1.46			
1.45			
1.44		1	1
1.43			
1.42	1		1
1.41			
1.40			
1.39			
1.38			
1.37			
1.36			
1.35			
1.34	1		1
1.33		1	1
n	4	4	8
$\bar{R}$	1.442	1.440	1.441
$\sigma_{\bar{R}}$			.07396
Min $\bar{R}$			1.392

e/D=2.0

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)/TUS(LT)
2.04	1		1
2.03	1		1
1.96	1		1
1.95			
1.94			
1.93			
1.92			
1.91		1	1
1.85		2	2
1.84			
1.83		1	1
1.82			
1.81			
1.80			
1.79			
1.78	1		1
n	4	4	8
$\bar{R}$	1.952	1.860	1.906
$\sigma_{\bar{R}}$			.09576
Min $\bar{R}$			1.842

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
1.85	1		1
1.84			
1.83			
1.82		1	1
1.81			
1.80			
1.79	1		
1.78			
1.77			
1.76			
1.75			
1.74			
1.73		1	1
1.72			
1.71			
1.70	1		1
1.69		1	1
1.61	1		1
1.60		1	1
n	4	4	8
$\bar{R}$	1.738	1.710	1.724
$\sigma_{\bar{R}}$			.09226
Min $\bar{R}$			1.662

* Students "f"-test showed no significant difference between the average ratios for the L and LT or LT and ST directions and the "f"-test showed no significant difference in variability for the L and LT or LT and ST directions.

TABLE XXV

STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND EDGEWISE BEARING PROPERTIES OF 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Ratio Cell	CYS(L)/TYS(L)	CYS(LT)/TYS(LT)	CYS(ST)/TYS(ST)
1.09			1
1.08	1	1	
1.07		1	1
1.06		2	
1.05			
1.04	1		2
1.03			
1.02			
1.01	1		
1.00			
0.99			
0.98			
0.97	1		
n	4	4	4
$\bar{R}$	1.025	1.068	1.060
$\sigma_{\bar{R}}$	.04655	.00957	.02449
Min $\bar{R}$	1.015	1.058	1.050

Ratio Cell	SUS(L)/TUS(LT)	SUS(LT)/TUS(LT)	SUS(ST)/TUS(LT)	SUS(L,LT&ST)*/TUS(LT)
0.65	1			1
0.64		1		1
0.63				
0.62	2	1	1	4
0.61				
0.60	1		1	2
0.59				
0.58		1	2	3
0.57				
0.56		1		1
n	4	4	4	12
$\bar{R}$	0.622	0.600	0.595	0.606
$\sigma_{\bar{R}}$				.02712
Min $\bar{R}$				0.592

e/D=1.5

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)*/TUS(LT)
1.62	1		1
1.61			
1.60			
1.59			
1.58	1		1
1.52		1	1
1.51		1	1
1.50			
1.49			
1.48	1	1	2
1.43		1	1
1.42			
1.41			
1.40			
1.39			
1.38	1		1
n	4	4	8
$\bar{R}$	1.515	1.485	1.500
$\sigma_{\bar{R}}$			.07690
Min $\bar{R}$			1.448

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)/TYS(LT)
1.63	1		1
1.52	1		1
1.51			
1.50			
1.49			
1.48	1	1	2
1.47		1	1
1.46			
1.45			
1.44			
1.43		1	1
1.42		1	1
1.41			
1.40			
1.39			
1.38	1		1
n	4	4	8
$\bar{R}$	1.502	1.450	1.476
$\sigma_{\bar{R}}$			.07577
Min $\bar{R}$			1.425

e/D=2.0

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)*/TUS(LT)
2.03	1		1
2.02			
2.01			
2.00			
1.99		1	1
1.98	1		1
1.97			
1.96			
1.95			
1.94			
1.93		1	1
1.92		2	2
1.91			
1.90	1		1
1.89			
1.88			
1.87			
1.86	1		1
n	4	4	8
$\bar{R}$	1.942	1.940	1.941

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
1.75	1		1
1.74	1	1	2
1.73			
1.72	1		1
1.71		1	1
1.70			
1.69			
1.68		1	1
1.67			
1.66			
1.65			
1.64	1		1
1.63		1	1
n	4	4	8
$\bar{R}$	1.712	1.690	1.701
$\sigma_{\bar{R}}$			.04643
Min $\bar{R}$			1.670

* Students "f"-test showed no significant difference between the average ratios for the L and LT and ST directions and the "f"-test showed no significant difference in variability for the L and LT and ST directions.

TABLE XXVI

STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND FLATWISE BEARING PROPERTIES OF BARE AND ALCLAD 7475-T61 SHEET

(F33615-71-C-1571)

Ratio Cell	TUS(L)/TUS(LT)	TYS(L)/TYS(LT)	CYS(L)/TYS(LT)	CYS(LT)/TYS(LT)
1.11				1
1.10				
1.09				5
1.08		1		5
1.07	1	2		10
1.06		2	2	10
1.05		5	1	6
1.04	2	8	9	1
1.03		11	7	
1.02	4	7	6	
1.01	4	1	7	
1.00	15		2	
0.99	8		1	
0.98	3		1	
0.97			1	
n	37	37	37	37
$\bar{R}$	1.003	1.038	1.024	1.068
$\sigma_{\bar{R}}$	.01697	.01606	.02003	.01535
Min $\bar{R}$	0.998	1.033	1.018	1.063

Ratio Cell	SU/TUS(LT)	SU(L)/TUS(LT)	SU(LT)/TUS(LT)	SU(L&LT)*/TUS(LT)
0.66		1		1
0.65	1	1	2	3
0.64	1	3	2	5
0.63	1		1	1
0.62	3			
0.61	3			
0.60	1			
0.59	1			
n	11	5	5	10
$\bar{R}$	0.618	0.646	0.642	0.644
$\sigma_{\bar{R}}$	.01722			.00843
Min $\bar{R}$	0.609			0.639

e/D=1.5

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)/TUS(LT)
1.74		1	1
1.73			
1.72	1		1
1.71			
1.70			
1.69	1	1	2
1.68			
1.67	1	1	2
1.66		1	1
1.65	2	2	4
1.64	4	4	8
1.63	4	4	8
1.62	8	3	11
1.61	6	10	16
1.60	5	4	9
1.59	1	1	2
1.58	2	3	5
1.57			
1.56	1		1
1.55			
1.54		1	1
n	36	36	72
$\bar{R}$	1.622	1.622	1.610‡
$\sigma_{\bar{R}}$			.03388‡
Min $\bar{R}$			1.60‡

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)/TYS(LT)
1.60		1	1
1.59	1	1	2
1.58	1	1	2
1.57	1	1	2
1.56	2	3	5
1.55	3	4	7
1.54	3	4	7
1.53	5	4	9
1.52	3	4	7
1.51	5	4	9
1.50	3	3	6
1.49	1	2	3
1.48	3		3
1.47	1	1	2
1.46			
1.45	1		1
1.44			
1.43	1	2	3
1.42			
1.41			
1.40	1		1
1.39			
1.38		1	1
1.37			
1.36	1		1
n	36	36	72
$\bar{R}$	1.512	1.522	1.512‡
$\sigma_{\bar{R}}$			.05227‡
Min $\bar{R}$			1.50‡

e/D=2.0

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)/TUS(LT)
2.20		1	1
2.19	1		1
2.18			
2.17	1		1
2.16			
2.15	1	1	2
2.14		1	1
2.13	1		1
2.12	1	1	2
2.11	1		1
2.10	1	2	3
2.09	4	2	6
2.08	3	4	7
2.07	6	10	16
2.06	3	2	5
2.05	5	2	7
2.04	4	3	7
2.03		2	2
2.02	1	1	2
2.01	1	1	2
2.00			
1.99		1	1
1.98			
1.97	1		1
1.96	1		1
1.92		1	1
1.86		1	1
n	36	36	72
$\bar{R}$	2.071	2.061	2.058‡
$\sigma_{\bar{R}}$			.04800‡
Min $\bar{R}$			2.05‡

Ratio Cell	BYS(L)/TYS(L)	BYS(LT)/TYS(LT)	BYS(L&LT)/TYS(LT)
1.86		2	2
1.85		1	1
1.84		2	2
1.83			
1.82		4	4
1.81		1	1
1.80	3	2	5
1.79	5		5
1.78	2	4	6
1.77	4	1	5
1.76	2	3	5
1.75	3	5	8
1.74	2	2	4
1.73	3		3
1.72	2		2
1.71	1		1
1.70	2	2	4
1.69	2	2	4
1.68		1	1
1.67	1		1
1.66		1	1
1.65			
1.64	1	1	2
1.63		1	1
1.62			
1.61	2		2
1.60			
1.59		1	1
1.58	1		1
n	36	36	72
$\bar{R}$	1.735	1.759	1.750‡
$\sigma_{\bar{R}}$			.06513‡
Min $\bar{R}$			1.75‡

* Students "t"-test showed - No significant difference between the average ratios for the L and LT directions and the "f" test showed no significant difference in variability for the L and LT directions.

‡ These values determined by analyzing all bare and alclad 7475-T61 and T761 ratios together.

TABLE XXVII

STATISTICAL ANALYSES OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND BEARING PROPERTIES OF BARE AND ALCLAD 7475-T761 SHEET

(F33615-71-C-1571)

Ratio Cell	TUS(L)/TUS(LT)	TYS(L)/TYS(LT)	CYS(L)/TYS(LT)	CYS(LT)/TYS(LT)
1.09				1
1.08				5
1.07				3
1.06			1	2
1.05		2	1	6
1.04		3	2	4
1.03	3	6	2	4
1.02	3	12	1	
1.01	4	1	6	1
1.00	6		7	
0.99	7	1	1	
0.98	2	1	1	
0.97	1		3	
0.96			1	
n	26	26	26	26
$\bar{R}$	1.002	1.024	1.007	1.054
$\sigma_{\bar{R}}$	.01617	0.01525	.02513	.02062
Min $\bar{R}$	0.996	1.019	0.998	1.047

Ratio Cell	SU/TUS(LT)	SU(L)/TUS(LT)	SU(LT)/TUS(LT)	SU(L&LT)*/TUS(LT)
0.65		3	1	4
0.64		3	3	6
0.63	2		2	2
0.62	3			
0.61	2			
0.60	1			
n	8	6	6	12
$\bar{R}$	0.620	0.645	0.638	0.642
$\sigma_{\bar{R}}$	0.01225			.00748
Min $\bar{R}$	0.608			.0638

e/D=1.5

Ratio Cell	BUS(L)/TUS(L)	BUS(LT)/TUS(LT)	BUS(L&LT)*/TUS(LT)	Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
1.65	1		1	1.59	1	1	2
1.64		1	1	1.58			
1.63		1	1	1.57			
1.62	4	1	5	1.56	3	3	6
1.61	5	3	8	1.55		2	2
1.60	6	7	13	1.54	3	2	5
1.59	2	3	5	1.53	4	3	7
1.58	1	4	5	1.52	3	2	5
1.57	2	1	3	1.51	3	3	6
1.56	1	1	2	1.50	1	1	2
1.55	1	3	4	1.49		1	1
1.54				1.48	2	2	4
1.53	1		1	1.47		1	1
1.52				1.46	1		1
1.51				1.45		1	1
1.50	1		1	1.44			
				1.43	1	1	2
				1.39		2	2
				1.38			
				1.37	1		1
				1.33	2		2
n	25	25	50		25	25	50
$\bar{R}$	1.593	1.592	1.610‡		1.499	1.508	1.512‡
$\sigma_{\bar{R}}$			.03386‡				.05227‡
Min $\bar{R}$			1.60‡				1.50‡

e/D=2.0

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)*/TUS(LT)	Ratio Cell	3YS(L)/TYS(LT)	B&S(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
2.16		1	1	1.86		1	1
				1.85			
2.13	1	1	2	1.84		1	1
2.12				1.83	2		2
2.11	1		1	1.82		4	4
2.10				1.81		3	3
2.09				1.80	3	2	5
2.08	4	2	6	1.79	2	2	4
2.07	3	1	4	1.78	1		1
2.06	1	2	3	1.77	3	3	6
2.05	3	7	10	1.76	4	2	6
2.04	1	2	3	1.75	1		1
2.03	5	1	6	1.74	1	1	2
2.02	1	1	2	1.73	2		2
2.01	1	4	5	1.72	1	1	2
2.00		2	2	1.71			
1.99	3		3	1.70			
1.98	1	1	2	1.69	1	1	2
1.97				1.68			
1.96				1.67	2	1	3
				1.66			
				1.65		1	1
				1.64		1	1
				1.63			
				1.62			
				1.61	1		1
				1.60			
				1.58		1	1
				1.54	1		1
n	25	25	50		25	25	50
$\bar{R}$	2.046	2.046	2.058‡		1.745	1.764	1.750‡
$\sigma_{\bar{R}}$			.04800‡				.06513‡
Min $\bar{R}$			2.05‡				1.75‡

* Students "t"-test showed no significant difference between the average ratios for the L and LT directions and the "f" test showed no significant difference in variability for the L and LT directions.

‡ These values determined by analyzing all bare and alclad 7475-T61 and T761 ratios together.

TABLE XXVIII

STATISTICAL ANALYSIS OF RATIOS AMONG TENSILE, COMPRESSIVE, SHEAR AND FLATWISE BEARING PROPERTIES OF 2124-T851 PLATE

(F33615-71-C-1571)

Ratio Cell	CYS(L)/TYS(L)	CYS(LT)/TYS(LT)	CYS(ST)/TYS(ST)
1.09			2
1.08			3
1.07			6
1.06	1		5
1.05			2
1.04			1
1.03		2	
1.02	2	6	
1.01		5	
1.00	2	4	
0.99	2	1	
0.98	6	1	
0.97			
0.96	3		
0.95	2		
0.94			
0.93			
0.92			
0.91	1		
n	19	19	19
$\bar{R}$	0.982	1.011	1.067
$\sigma_{\bar{R}}$	.00734**	.01311	.01327
Min $\bar{R}$	1.006-0.946	1.005	1.062

Ratio Cell	SUS(L)/TS(LT)	SUS(LT)/TS(LT)	SUS(L&LT)*/TS(LT)	SUS(ST)/TS(LT)
0.60	1	3	4	
0.59	7	4	11	
0.58	8	8	16	2
0.57				2
0.56	1	2	3	7
0.55	2	2	4	2
0.54				1
0.53				4
0.52				1
n	19	19	38	19
$\bar{R}$	0.581	0.580	0.580	0.553
$\sigma_{\bar{R}}$			.00327**	.00411**
Min $\bar{R}$			0.566-0.587	0.534-0.558

e/D=1.5

Ratio Cell	BUS(L)/TUS(LT)	BUS(LT)/TUS(LT)	BUS(L&LT)*/TUS(LT)
1.53		1	1
1.52	1	2	3
1.51	1	4	5
1.50	4	1	5
1.49	4	2	6
1.48		1	1
1.47	1		1
1.46		1	1
1.45	2	1	3
1.44		1	1
1.43	1		1
1.42		1	1
1.41			
1.40	1		1
n	15	15	30
$\bar{R}$	1.479	1.489	1.484
$\sigma_{\bar{R}}$			.03277
Min $\bar{R}$			1.474

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
1.53		1	1
1.52	3		3
1.57		1	1
1.50			
1.49		1	1
1.48		1	1
1.47	1	1	2
1.46	3	1	4
1.45	1	1	2
1.44	1	1	2
1.43	1	3	4
1.42		1	1
1.41	1		1
1.40	1	1	2
1.39			
1.38	1		1
1.37	1	1	2
1.36	1	1	2
1.35			
n	15	15	30
$\bar{R}$	1.443	1.444	1.444
$\sigma_{\bar{R}}$			.00900**
Min $\bar{R}$			1.388-1.482

e/D=2.0

Ratio Cell	BUS(L)/TS(LT)	BUS(LT)/TS(LT)	BUS(L&LT)*/TS(LT)
1.96	2	4	6
1.95	5	2	7
1.94	2	3	5
1.93		1	1
1.92	1	1	2
1.91			
1.90	1		1
1.89	2	2	4
1.88			
1.87		1	1
1.86	1		1
1.85	1	1	2
n	15	15	30
$\bar{R}$	1.924	1.927	1.926
$\sigma_{\bar{R}}$			.03569
Min $\bar{R}$			1.915

Ratio Cell	BYS(L)/TYS(LT)	BYS(LT)/TYS(LT)	BYS(L&LT)*/TYS(LT)
1.77		1	1
1.76	1		1
1.75	1		1
1.74	1		1
1.73			
1.72		1	1
1.71	1	2	3
1.70		1	1
1.69	1		1
1.68	2		2
1.67	1	3	4
1.66	2	2	4
1.65			
1.64	1	1	2
1.63		1	1
1.62	1		1
1.61	1		1
1.60	1	1	2
1.59	1	2	3
n	15	15	30
$\bar{R}$	1.671	1.666	1.668
$\sigma_{\bar{R}}$			.00941**
Min $\bar{R}$			1.608-1.711

* Students "t"-test showed no significant difference between average ratios for L and LT directions and "f"-test showed no significant difference in variability for L and LT directions.
** Regression analysis showed significant relationship with thickness, value show is $\sigma_e/\sqrt{n}$.

TABLE XXIX

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF 7049-T73 DIE FORGINGS

(F33615-71-C-1571)

Ratio	Thickness, in. ≤1.000	1.001-2.000	2.001-3.000	4.001-5.000
$F_{cy}(L)/F_{ty}(L)$	1.036	1.036	1.036	1.036
$F_{cy}(ST)F_{ty}(ST)$	1.036	1.036	1.036	1.036
$F_{su}/F_{tu}(L)$	0.567	0.567	0.567	0.567
$F_{bru}(L)/F_{tu}(L)$				
e/D=1.5	1.40	1.40	1.40	1.40
e/D=2.0	1.85	1.85	1.85	1.85
$F_{bry}(L)/F_{ty}(L)$				
e/D=1.5	1.30	1.30	1.30	1.30
e/D=2.0	1.55	1.55	1.55	1.55

TABLE XXX

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Ratio	Thickness, in. ≤1.000	1.001-2.000	2.001-3.000
$F_{cy}(L)/F_{ty}(L)$	1.018	1.018	1.018
$F_{cy}(ST)/F_{ty}(ST)$	1.055	1.040	1.024
$F_{su}/F_{tu}(L)$	0.572	0.572	0.572
$F_{bru}(L)/F_{tu}(L)$			
e/D=1.5	1.40	1.40	1.40
e/D=2.0	1.85	1.85	1.85
$F_{bry}(L)/F_{ty}(L)$			
e/D=1.5	1.30	1.30	1.30
e/D=2.0	1.55	1.55	1.55

TABLE XXXI

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF 7049-T73 HAND FORGINGS

(F33615-71-C-1571)

Ratio	Thickness, in. ≤2.000	2.001-3.000	3.001-4.000	4.001-5.000
$F_{cy}(L)/F_{ty}(L)$	1.008	1.008	1.008	1.008
$F_{cy}(LT)/F_{ty}(LT)$	1.028	1.028	1.028	1.028
$F_{cy}(ST)/F_{cy}(ST)$	1.072	1.072	1.072	1.072
$F_{su}/F_{tu}(LT)$	0.570	0.570	0.570	0.570
$F_{bru}/F_{tu}(LT)$				
e/D=1.5	1.40	1.40	1.40	1.40
e/D=2.0	1.85	1.85	1.85	1.85
$F_{bry}/F_{ty}(LT)$				
e/D=1.5	1.40	1.40	1.40	1.40
e/D=2.0	1.65	1.65	1.65	1.65

TABLE XXVII

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES
OF 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Ratio	Thickness, in. ≤3.000	3.001-4.000	4.001-5.000
$F_{cy}(L)/F_{ty}(L)$	1.015	1.015	1.015
$F_{cy}(LT)/F_{ty}(LT)$	1.058	1.058	1.058
$F_{cy}(ST)/F_{ty}(ST)$	1.050	1.050	1.050
$F_{su}/F_{tu}(LT)$	0.592	0.592	0.592
$F_{bru}/F_{tu}(LT)$			
e/D=1.5	1.45	1.45	1.45
e/D=2.0	1.90	1.90	1.90
$F_{bry}/F_{ty}(LT)$			
e/D=1.5	1.40	1.40	1.40
e/D=2.0	1.65	1.65	1.65

TABLE XXXIII

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF BARE AND ALCLAD 7475-T61 AND T761 SHEET

(F33615-71-C-1571)

Ratios	T61 Thickness, in. 0.040-0.249	T761 Thickness, in. 0.040-0.249
$F_{tu}(L)/F_{tu}(LT)$	0.998	0.996
$F_{ty}(L)/F_{ty}(LT)$	1.033	1.019
$F_{cy}(L)/F_{ty}(LT)$	1.018	0.998
$F_{cy}(LT)/F_{ty}(LT)$	1.063	1.047
$F_{su}/F_{tu}(LT)$	0.609	0.611
$F_{bru}/F_{tu}(LT)$		
e/D=1.5	1.60	1.60
e/D=2.0	2.05	2.05
$F_{bry}/F_{ty}(LT)$		
e/D=1.5	1.50	1.50
e/D=2.0	1.75	1.75

TABLE XXXIV

RATIOS FOR COMPUTING DESIGN MECHANICAL PROPERTIES OF 2124-T851 PLATE

(F33615-71-C-1571)

Ratio	Thickness, in. 1.501-2.000	2.001-3.000	3.001-4.000	4.001-5.000	5.001-6.000
$F_{cy}(L)/F_{ty}(L)$	1.006	0.998	0.980	0.963	0.946
$F_{cy}(LT)/F_{ty}(LT)$	1.005	1.005	1.005	1.005	1.005
$F_{cy}(ST)/F_{ty}(ST)$	1.062	1.062	1.062	1.062	1.062
$F_{su}/F_{tu}(LT)$	0.534	0.537	0.544	0.551	0.558
$F_{bru}/F_{tu}(LT)$					
e/D=1.5	1.45	1.45	1.45	1.45	1.45
e/D=2.0	1.90	1.90	1.90	1.90	1.90
$F_{bry}/F_{ty}(LT)$					
e/D=1.5	1.40	1.40	1.45	1.45	1.50
e/D=2.0	1.60	1.60	1.65	1.65	1.70

TABLE XXXV

COMPUTED DESIGN MECHANICAL PROPERTIES OF
7049-T73 DIE FORGINGS
(F33615-71-C-1571)

Alloy	7049			
Form	Die Forging			
Condition	T73			
Thickness, in.	≤1.000	1.001-2.000	2.001-3.000	4.001-5.000
Basis	S	S	S	S
Mechanical Properties:				
F_{tu}, ksi				
L	72	72	71	70
ST	71	70	70	68
F_{ty}, ksi				
L	62	62	61	60
ST	61	60	60	58
F_{cy}, ksi				
L	64*	64*	63*	62*
ST	63*	62*	62*	60*
F_{su}, ksi	41*	41*	40*	39*
F_{bru}(L), ksi				
e/D=1.5	101*	101*	99*	98*
e/D=2.0	133*	133*	131*	129*
F_{bry}(L), ksi				
e/D=1.5	80*	80*	79*	78*
e/D=2.0	96*	96*	95*	93*
e, per cent				
L	7	7	7	7
ST	3	3	3	2
E, 10^3 ksi	10.2			
E_c, 10^3 ksi	10.7 (-0.1)			
G, 10^3 ksi	3.9			

* No values shown in MIL-HDBK-5B, September 1971.

TABLE XXXVI

COMPUTED DESIGN MECHANICAL PROPERTIES*
OF 7175-T736 DIE FORGINGS
(F33615-71-C-1571)

Alloy	7175-T736		
Form	Die Forging		
Condition	T736		
Thickness, in.	≤1.000	1.001-2.000	2.001-3.000
Basis	S	S	S
Mechanical Properties:			
F_{tu}, ksi			
L	76	76	76
ST	71	71	71
F_{ty}, ksi			
L	66	66	66
ST	62	62	62
F_{cy}, ksi			
L	67	67	67
ST	65	64	63
F_{su}, ksi	43	43	43
F_{bru}(L), ksi			
e/D=1.5	106	106	106
e/D=2.0	140	140	140
F_{bry}(L), ksi			
e/D=1.5	86	86	86
e/D=2.0	102	102	102
e, per cent			
L	7	7	7
ST	4	4	4
E, 10^3 ksi	10.2		
E_c, 10^3 ksi	10.7		
G, 10^3 ksi	3.9		

* No values shown in MIL-HDBK-5B, September 1971.

TABLE XXXVII

COMPUTED DESIGN MECHANICAL PROPERTIES OF 7049-T73 HAND FORGINGS (F33615-71-C-1571)

Alloy	7049			
Form	Hand Forging			
Condition	T73			
Thickness, in.	≤2.000	2.001-3.000	3.001-4.000	4.001-5.000
Basis		S	S	S
Mechanical Properties;				
F_{tu}, ksi				
L	--	71	69	67
LT	--	71	69	67
ST	--	69	67	66
F_{ty}, ksi				
L	--	61	59	56
LT	--	59	57	56
ST	--	58	56	55
F_{cy}, ksi				
L	--	61 (-2)	59 (-2)	56 (-2)
LT	--	60 (-1)	58 (-1)	57 (-1)
ST	--	59 *	60 *	59 *
F_{su}, ksi	--	40 (+2)	39 (+2)	38 (+2)
F_{bru}, ksi				
e/D=1.5	--	99 *	96 *	94 *
e/D=2.0	--	131 *	127 *	124 *
F_{bry}, ksi				
e/D=1.5	--	82 *	80 *	78 *
e/D=2.0	--	97 *	94 *	92 *
e, per cent				
L	--	9	8	7
LT	--	4	3	3
ST	--	3	2	2
E, 10^3 ksi	10.2			
E_c, 10^3 ksi	10.6			
G, 10^3 ksi	3.9			

NOTE: Numbers in parenthesis are differences from values from MIL-HDBK-5A, September, 1971.

* No values shown in MIL-HDBK-5B, September 1971.

TABLE XXXVIII

COMPUTED DESIGN MECHANICAL PROPERTIES*
OF 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Alloy	7175		
Form	Hand Forging		
Condition	T736		
Thickness, in.	≤3.000	3.001-4.000	4.001-5.000
Basis			
Mechanical Properties:			
F_{tu}, ksi			
L	73	71	68
LT	71	70	67
ST	69	68	66
F_{ty}, ksi			
L	63	61	57
LT	60	58	56
ST	60	57	55
F_{cy}, ksi			
L	64	62	58
LT	63	61	59
ST	63	60	58
F_{su}, ksi	42	41	39
F_{bru}, ksi			
e/D=1.5	103	101	97
e/D=2.0	135	133	127
F_{bry}, ksi			
e/D=1.5	84	81	78
e/D=2.0	99	96	92
e, per cent			
L	9	9	8
LT	5	5	5
ST	4	4	4
E, 10^3 ksi	10.2		
E_c, 10^3 ksi	10.6		
G, 10^3 ksi	3.9		

* No values shown in MIL-HDBK-5B, September 1971.

TABLE XXXIX

COMPUTED DESIGN MECHANICAL PROPERTIES* OF BARE AND ALCLAD 7475-T61 SHEET

(F33615-71-C-1571)

Alloy	7475			
Form	Bare Sheet	Alclad Sheet		
Condition	T61	T61		
Thickness, in.	0.040- 0.249	0.040- 0.062	0.063- 0.187	0.188- 0.249
Basis				
Mechanical Properties:				
F_{tu}, ksi				
L	75	69	70	72
LT	75	69	70	72
F_{ty}, ksi				
L	66	61	62	63
LT	64	59	60	61
F_{cy}, ksi				
L	65	60	61	62
LT	68	63	64	65
F_{su}, ksi	45	42	42	44
F_{bru}, ksi				
e/D=1.5	120	110	112	115
e/D=2.0	154	141	143	147
F_{bry}, ksi				
e/D=1.5	96	88	90	91
e/D=2.0	112	103	105	107
e, per cent				
L	--	--	--	--
LT	9	9	9	9
E, 10^3 ksi	10.0	10.0‡		
E_c, 10^3 ksi	10.5	10.5‡		
G, 10^3 ksi	3.8	3.8‡		

* No values shown in MIL-HDBK-5B, September, 1971.
‡ Primary modulus values, secondary values not determined.

TABLE XL

COMPUTED DESIGN MECHANICAL PROPERTIES* OF BARE AND ALCLAD 7475-T761 SHEET

(F33615-71-C-1571)

Alloy	7475			
Form	Bare Sheet	Alclad Sheet		
Condition	T761	T761		
Thickness, in.	0.040-0.249	0.040-0.062	0.063-0.287	0.188-0.249
Basis				
Mechanical Properties:				
F_{tu}, ksi				
L	71	66	67	69
LT	71	66	67	69
F_{ty}, ksi				
L	61	56	57	58
LT	60	55	56	57
F_{cy}, ksi				
L	60	55	56	57
LT	63	57	58	59
F_{su}, ksi	43	40	41	42
F_{bru}, ksi				
e/D=1.5	113	105	107	110
e/D=2.0	145	135	137	141
F_{bry}, ksi				
e/D=1.5	90	82	84	85
e/D=2.0	105	96	98	100
e, per cent				
L	--	--	--	--
LT	9	9	9	9
E, 10^3 ksi	10.0	10.0‡		
E_c, 10^3 ksi	10.5	10.5‡		
G, 10^3 ksi	3.8	3.8‡		

* No values shown in MIL-HDBK-5B, September, 1971.
‡ Primary modulus values, secondary values not determined.

TABLE XLI

COMPUTED DESIGN MECHANICAL PROPERTIES* OF 2124-T851 PLATE

(F33615-71-C-1571)

Alloy	2124				
Form	Plate				
Condition	T851				
Thickness, in.	1.501-2.000	2.001-3.000	3.001-4.000	4.001-5.000	5.001-6.000
Basis					
Mechanical Properties:					
F_{tu}, ksi					
L	66	65	65	64	63
LT	66	65	65	64	63
ST	64	63	62	61	59
F_{ty}, ksi					
L	57	57	56	55	54
LT	57	57	56	55	54
ST	55	55	54	53	51
F_{cy}, ksi					
L	57	57	55	53	51
LT	57	57	56	55	54
ST	58	58	57	56	54
F_{su}, ksi	35	35	35	35	35
F_{bru}, ksi					
e/D=1.5	96	94	94	93	91
e/D=2.0	125	123	123	121	120
F_{bry}, ksi					
e/D=1.5	80	80	81	81	81
e/D=2.0	91	91	92	92	92
e, per cent					
L	6	6	5	5	5
LT	5	4	4	4	4
ST	1.5	1.5	1.5	1.5	1.5
E, 10^3 ksi	10.4				
E_c, 10^3 ksi	10.9				
G, 10^3 ksi	4.0				

* No values shown in MIL-HDBK-5B, September 1971.

TABLE XLII

RESULTS OF TENSILE AND COMPRESSIVE STRESS-STRAIN AND MODULUS OF ELASTICITY TESTS OF 7049-T73 AND 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Alloy and Temper	Sample		Die No.	Producer	Longitudinal				Short-Transverse			
					Tensile		Compressive		Tensile		Compressive	
	Number	Thickness, in.			Yield Strength,* ksi	Modulus 10^3 ksi	Yield Strength,* ksi	Modulus 10^3 ksi	Yield Strength,* ksi	Modulus 10^3 ksi	Yield Strength,* ksi	Modulus 10^3 ksi
7049-T73	410693	≤1.000	9078	A	72.7	10.52	73.8	10.69	61.7	10.51	65.5	10.79
	410698	1.001-2.000	15789	A	73.4	10.07	79.5	10.61	69.9	10.07	74.7	10.49
	410697A		40005	A	74.9	10.61	81.7	11.21	65.4	10.24	71.8	11.01
	410695	2.001-3.000	40006	A	71.4	10.51	74.4	10.87	64.8	10.18	67.8	10.84
		Avg				10.43		10.84		10.20		10.78
7175-T736	410983	≤1.000	9078	A	67.5	10.23	72.8	10.62	61.0	10.12	67.0	10.60
	410699	1.001-2.000	15789	A	76.0	10.27	75.2	10.72	67.4	10.18	71.2	10.61
	410705A		40005	A	73.8	10.29	75.5	10.67	64.0	10.16	69.5	10.60
	410984	2.001-3.000	40006	A	67.9	10.26	71.8	10.59	61.8	9.98	65.0	10.52
		Avg				10.26		10.65		10.11		10.58

* Offset equals 0.2 per cent.

TABLE XLIII

RESULTS OF TENSILE AND COMPRESSIVE STRESS-STRAIN AND MODULUS OF ELASTICITY TESTS OF 7049-T73 AND 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Alloy and Temper	Sample		Producer	Longitudinal				Long-Transverse				Short-Transverse			
				Tensile		Compressive		Tensile		Compressive		Tensile		Compressive	
	Number	Thickness, in.		Yield Strength,* ksi	Modulus 10^3 ksi	Yield Strength, ksi	Modulus 10^3 ksi	Yield Strength,* ksi	Modulus 10^3 ksi	Yield Strength ksi	Modulus 10^3 ksi	Yield Strength ksi	Modulus 10^3 ksi	Yield Strength ksi	Modulus 10^3 ksi
7049-T73	411019	2x16	A	68.0	10.10	73.1	10.53	65.3	10.20	69.4	10.49	66.8	10.34	71.7	10.65
	410686	3x16	A	63.6	10.20	68.9	10.50	65.3	10.37	70.1	10.63	63.5	10.14	66.4	10.63
	410966	4x16	A	69.3	10.00	69.8	10.47	63.0	10.24	68.0	10.68	66.9	10.06	69.3	10.47
	410688	5x20	A	60.0	10.08	63.6	10.53	57.5	10.40	62.2	10.81	59.5	10.29	62.1	10.60
		Avg			10.10		10.51		10.30		10.65		10.21		10.59
7175-T736	410689	2x16	A	67.1	10.10	70.0	10.50	65.3	10.31	72.1	10.95	66.5	10.07	69.0	10.59
	410985	3x12	A	65.4	10.04	71.4	10.43	65.3	10.17	70.0	10.57	66.0	9.96	70.1	10.54
	410691	4x16	A	61.5	10.41	66.7	10.71	59.9	10.24	65.6	10.89	59.9	10.41	64.1	10.68
	410986	5x20	A	60.6	10.04	67.4	10.47	59.0	10.21	63.6	10.60	57.6	10.08	64.3	10.53
		Avg			10.15		10.53		10.23		10.75		10.13		10.58

* Offset equals 0.2 per cent.

TABLE XLIV

RESULTS OF TENSILE AND COMPRESSIVE STRESS-STRAIN AND MODULUS OF ELASTICITY TESTS OF 7475-T61 AND T761 SHEET

(F33615-71-C-1571)

	Sample			Longitudinal				Transverse			
				Tensile		Compressive		Tensile		Compressive	
Temper	Number	Thickness, in.	Producer	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi
T61	410651	0.040	A	75.1	10.12	72.7	10.50	71.7	10.03	76.0	10.48
	410653	0.063	A	74.3	9.97	71.9	10.36	72.3	9.95	76.7	10.53
	410655	0.090	A	74.2	9.89	74.9	10.34	71.3	9.92	76.4	10.43
	410657	0.125	A	73.9	10.04	75.4	10.60	72.2	10.02	77.4	10.58
	410659	0.188	A	75.2	10.00	72.4	10.57	71.1	10.10	76.6	10.58
	410661	0.249	A	75.1	10.17	73.2	10.39	72.3	10.17	77.5	10.60
			Avg		10.03		10.46		10.03		10.53
T761	410888	0.032	A	73.2	10.23	69.9	10.55	69.7	10.16	71.9	10.54
	410663	0.040	A	71.7	10.11	69.9	10.45	69.0	9.92	71.6	10.39
	410665	0.063	A	70.1	10.11	73.2	10.61	68.2	10.00	72.8	10.63
	410667	0.090	A	66.6	9.89	65.1	10.27	63.8	9.98	67.0	10.27
	410669	0.125	A	66.0	10.26	65.2	10.46	64.5	10.11	69.9	10.71
	410671	0.188	A	65.0	9.97	63.2	10.52	63.6	10.03	67.7	10.62
	410673	0.249	A	65.9	10.10	64.1	10.44	64.7	10.10	68.7	10.58
			Avg		10.09		10.47		10.04		10.53

* Offset equals 0.2 per cent.

TABLE XLV

RESULTS OF TENSILE AND COMPRESSIVE STRESS-STRAIN AND MODULUS OF ELASTICITY TESTS OF 2124-T851 PLATE
(F33615-71-C-1571)

Sample			Longitudinal				Long-Transverse				Short-Transverse			
			Tensile		Compressive		Tensile		Compressive		Tensile		Compressive	
Number	Thickness, in.	Producer	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi	Yield Strength,* ksi	Modulus, 10^3 ksi
410675	1.750	A	67.5	10.49	67.2	10.90	65.5	10.48	68.5	11.02	63.6	10.05	69.0	10.84
410676	2.500	A	65.4	10.45	65.1	10.98	63.9	10.50	66.1	10.84	62.4	10.35	67.1	10.81
410677	3.500	A	63.6	10.39	63.0	10.84	62.5	10.38	64.4	10.94	62.0	10.47	65.6	10.87
410678	4.500	A	63.9	10.37	62.4	10.77	61.5	10.59	64.0	11.04	59.4	10.45	63.9	10.84
410679	5.500	A	61.2	10.55	59.2	10.85	59.3	10.53	60.7	10.90	57.5	10.47	62.5	10.86
		Avg		10.45		10.87		10.50		10.95		10.36		10.84

* Offset equals 0.2 per cent.

TABLE XLVI

SUMMARY OF AVERAGE MODULUS VALUES OF 7049-T73
AND 7175-T736 FORGINGS, 7475-T61 AND T761 SHEET AND 2124-T851 PLATE

(F33615-71-C-1571)

Alloy and Temper	Product	Average Modulus of Elasticity Values, 10^3 ksi					
		Tension			Compression		
		Longitudinal	Long-Transverse	Short-Transverse	Longitudinal	Long-Transverse	Short-Transverse
7049-T73	Die Forging	10.43	--	10.20	10.84	--	10.78
	Hand Forging	10.10	10.30	10.21	10.51	10.65	10.59
7175-T736	Die Forging	10.26	--	10.11	10.65	--	10.58
	Hand Forging	10.15	10.23	10.13	10.53	10.75	10.58
7475-T61	Sheet	10.03	10.03	--	10.46	10.53	--
-T761	Sheet	10.09	10.04	--	10.47	10.53	--
2124-T851	Plate	10.45	10.50	10.36	10.87	10.95	10.84
		Averages*, All Directions					
7049 7175	Die Forgings		10.2			10.7	
7049 7175	Hand Forgings		10.2			10.6	
7475	Sheet		10.0			10.5	
2124	Plate		10.4			10.9	

* Values rounded to nearest 100 ksi.

TABLE XLVII

TYPICAL TENSILE AND COMPRESSIVE PROPERTIES

(F33615-71-C-1571)

Alloy and Temper	Product	Thickness Range, in.	Direction	Typical			
				Tensile Strength, ksi	Yield Strength,* ksi	Elong, %	Compressive Yield Strength,* ksi
7049-T73	Die Forging	≤ 4.000	L	77.0	67.0	12.0	71.0
			ST	76.0	66.0	8.0	69.0
	Hand Forging	2.001-5.000	L	75.0	65.0	12.0	66.0
			LT	75.0	63.0	7.0	65.0
			ST	73.0	62.0	5.0	67.0
7175-T736	Die Forging	≤ 3.000	L	80.0	73.0	14.0	76.0
			ST	76.0	67.0	10.0	71.0
	Hand Forging	≤ 4.000	L	77.0	68.0	14.0	70.0
			LT	75.0	66.0	11.0	70.0
			ST	74.0	65.0	9.0	69.0
7475-T61	Sheet	0.040-0.249	L	--	75.0	--	73.0
			LT	80.0	72.0	12.0	76.0
-T761	Sheet	0.040-0.249	L	--	69.0	--	67.0
			LT	76.0	67.0	12.0	70.0
2124-T851	Plate	1.501-5.000	L	70.0	64.0	9.0	63.0
			LT	69.0	63.0	7.0	64.0
			ST	67.0	61.0	4.0	65.0

* Offset equals 0.2 per cent.

TABLE XLVIII

RESULTS OF COMPACT-TENSION FRACTURE TOUGHNESS TESTS OF 7049-T73 DIE FORGINGS

(F33615-71-C-1571)

Sample Number	Sample Thickness Range, in.	Die No.	Producer	Orientation†	Tensile Yield Strength, (σ_{YS}) ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5\left(\frac{K_Q}{\sigma_{YS}}\right)^2$	K_Q, ksi$\sqrt{in.}$	Valid ?
410693	≤ 1.000	9078	A	LS	74.5	L1	0.50	0.50	0.39	29.3	No(3)
						L2	0.50	0.50	0.41	30.1	No(3)
				Avg							
				SL	61.8	N1	0.50	0.51	0.36	23.7	Yes
						N2	0.50	0.50	0.37	24.0	Yes
				Avg						23.8	
410698	1.001-2.000	15789	A	LS	74.9	L1	1.00	1.06	0.36	28.5	Yes
						L2	1.00	1.15	0.42	30.5	No
				Avg							
				SL	70.8	N1	1.00	1.10	0.16	17.1	No(8)
						N2	1.00	1.09	0.16	18.0	No(8)
				Avg							
410694		B5786	B	LT	67.0	L1	0.50	0.47	0.45	28.3	Yes
						L2	0.50	0.48	0.46	28.7	Yes
				Avg						28.5	
				SL	66.1	N1	0.50	0.49	0.21	19.1	Yes
						N2	0.50	0.52	0.22	19.6	Yes
				Avg						19.4	
410697-A		40005	A	LT	71.6	L1	0.50	0.48	0.53	33.1	No(1,2,3)
						L2	0.50	0.50	0.57	34.1	No(1,2)
				Avg							
				SL	67.6	N1	0.75	0.80	0.29	23.1	Yes
						N2	0.75	0.80	0.30	23.4	Yes
				Avg						23.2	
410697-C		40005	A	LT	74.4	L5	0.50	0.48	0.42	30.6	Yes
						L6	0.50	0.49	0.43	30.8	Yes
				Avg						30.7	
				SL	67.1	N5	0.50	0.46	0.31	23.5	Yes
						N6	0.50	0.48	0.27	21.9	Yes
				Avg						22.7	
410695	2.001-3.000	40006	A	LS	73.1	L1	0.75	0.78	0.53	33.6	Yes
						L2	0.75	0.79	0.50	32.6	No(3)
				Avg							
				SL	66.3	N1	0.75	0.79	0.27	22.4	Yes
						N2	0.75	0.79	0.26	21.8	Yes
				Avg						22.1	
410696		B6204	B	LT	65.5	L1	0.75	0.80	0.64	33.2	Yes
						L2	0.75	0.79	0.69	34.3	Yes
				Avg						33.8	
				SL	64.7	N1	0.75	0.77	0.32	23.0	Yes
						N2	0.75	0.77	0.41	26.2	Yes
				Avg						24.6	
410697-B		40005	A	LT	75.9	L3	0.75	0.82	0.55	35.5	No(3,6)
						L4	0.75	0.83	0.60	37.2	Yes
				Avg							
				SL	64.9	N3	0.75	0.82	0.38	25.4	Yes
						N4	0.75	0.81	0.37	25.1	Yes
				Avg						25.2	
410700	4.001-5.000	B2362	B	LT	65.7	L1	0.75	0.78	0.49	29.2	Yes
						L2	0.75	0.79	0.49	29.1	Yes
				Avg						29.2	
				SL	65.5	N1	0.75	0.79	0.18	18.7	Yes
						N2	0.75	0.78	0.17	18.4	Yes
				Avg						18.6	

(1) Specimen not thick enough.
(2) Fatigue crack too short.
(3) Excessive yielding before crack extrusion, value considered meaningful.
(6) Fatigue crack front curvature exceeded allowed amount, value considered meaningful.
(8) Stress-intensity was too high for the last step of fatigue cracking; value considered meaningful.

† Refer to Fig.15 for description of orientation.

TABLE XLIX

RESULTS OF COMPACT-TENSION FRACTURE TOUGHNESS TESTS OF
7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Sample Number	Sample Thickness Range, in.	Die No.	Producer	Orientation*	Tensile Yield Strength, (σ_{YS}) ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5\left(\frac{K_Q}{\sigma_{YS}}\right)^2$	K_Q, ksi$\sqrt{in.}$	Valid
410983	≤1.000	9078	A	LS	69.3	L1	0.50	1.05	1.00	43.9	No(1,3)
						L2	0.50	1.08	0.80	39.2	No(1,3,6)
				Avg							
				SL	62.2	N1	0.49	1.07	0.65	31.6	No(1)
						N2	0.49	1.05	0.58	29.9	No(1)
				Avg							
410699	1.001-2.000	15789	A	LS	74.7	L1	1.00	1.13	0.52	33.9	No(3,4,6)
						L2	0.99	1.14	0.54	34.8	No(3,4,6)
				Avg							
				SL	67.0	N1	1.00	1.16	0.28	22.5	No(4,6)
						N2	1.00	1.10	0.35	25.2	No(6)
				Avg							
410704		F17961	A	LT	76.9	L1	0.50	0.48	0.42	31.5	Yes
						L2	0.50	0.48	0.56	36.3	No(1,2,3)
				Avg							
				SL	68.4	N1	0.50	0.46	0.25	21.5	No(6)
						N2	0.50	0.49	0.28	22.7	Yes
				Avg							
410705-A		40005	A	LT	69.8	L1	0.50	0.51	0.73	37.7	No(1,2,3)
						L2	0.50	0.48	0.81	39.8	No(1,2,3)
				Avg							
				SL	65.2	N1	0.75	0.90	0.39	25.9	No(4,6)
						N2	0.75	0.83	0.40	26.0	Yes
				Avg							
410705-C		40005	A	LT	72.4	L5	0.50	0.49	0.52	33.0	No(1,2,3)
						L6	0.50	0.50	0.55	34.0	No(1,2,3)
				Avg							
				SL	67.4	N5	0.50	0.50	0.37	25.8	Yes
						N6	0.50	0.49	0.35	25.1	Yes
				Avg						25.4	
410706		F17976	A	LS	73.2	L1	0.75	0.78	0.58	35.3	No(3)
						L2	0.75	0.77	0.69	38.4	No(3)
				Avg							
				SL	66.7	N1	0.75	0.85	0.36	25.2	No(4,6)
						N2	0.75	0.83	0.33	24.1	Yes
				Avg							
410705-B	2.001-3.000	40005	A	LT	71.8	L3	0.75	0.85	0.39	28.2	No(4,6)
						L4	0.75	0.87	0.42	29.3	No(4,6)
				Avg							
				SL	66.4	N3	0.75	0.85	0.41	27.0	No(4,6)
						N4	0.75	0.87	0.44	27.8	No(4,6)
				Avg							
410984		40006	A	LS	68.0	L3	0.75	0.78	0.71	36.2	No(3)
						L4	0.75	0.65	0.84	39.5	No(1,2,3,4,6)
				Avg							
				SL	62.6	N3	0.75	0.80	0.49	27.6	Yes
						N4	0.75	0.78	0.53	28.8	Yes
				Avg						28.2	

(1) Specimen not thick enough.
(2) Fatigue crack too short.
(3) Excessive yielding before crack extension, value considered meaningful.
(4) Crack length/width (A/W) not between 0.45 and 0.55, value considered meaningful.
(6) Fatigue crack front curvature exceeded allowed amount, value considered meaningful.

* Refer to Fig.15 for description of orientation.

TABLE L

RESULTS OF COMPACT-TENSION FRACTURE TOUGHNESS TESTS OF 7049-T73 AND 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

(L-T) Orientation#

Alloy and Temper	Sample Number	Sample Dimensions, in.	Producer	Tensile Yield Strength, (σ_{YS}) ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5\left(\frac{K_Q}{\sigma_{YS}}\right)^2$	K_Q, ksi$\sqrt{in.}$	Valid
7049-T73	411019	2x16	A	68.8	L3	1.00	1.04	0.42	28.3	Yes
					L4	1.00	1.11	0.36	26.2	No(6)
			Avg							
	410686	3x16	A	65.4	L1	1.00	1.09	0.54	30.3	Yes
					L2	1.00	1.10	0.57	31.4	Yes
			Avg						30.8	
	410966	4x16	A	72.8	L1	1.00	1.08	0.55	34.2	Yes
					L2	1.00	1.09	0.47	31.5	Yes
			Avg						32.8	
	410688	5x20	A	60.1	L1	1.00	1.04	0.47	25.9	Yes
					L2	1.00	1.06	0.52	27.4	Yes
			Avg						26.6	
7175-T736	410689	2x16	A	67.2	L1	1.00	1.10	0.70	35.5	No(3)
					L2	1.00	1.16	0.79	37.7	No(3,4,6)
			Avg							
	410985	3x12	A	70.8	L1	1.00	1.12	0.60	34.8	No(4,6)
					L2	1.00	1.11	0.54	33.0	No(4)
	410691	4x16	A	62.4	L1	1.00	1.07	0.76	34.3	No(3)
					L2	1.00	1.06	0.76	34.4	No(3)
			Avg							
	410986	5x20	A	62.1	L1	1.50	1.51	0.75	33.9	No(6)
					L2	1.50	1.64	0.73	33.6	Yes
			Avg							

(T-L) Orientation#

Alloy and Temper	Sample Number	Sample Dimensions, in.	Producer	Tensile Yield Strength, (σ_{YS}) ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5\left(\frac{K_Q}{\sigma_{YS}}\right)^2$	K_Q, ksi$\sqrt{in.}$	Valid
7049-T73	411019	2x16	A	67.0	T3	1.00	1.02	0.20	18.7	Yes
					T4	1.00	1.10	0.20	19.1	No(6)
			Avg							
	410686	3x16	A	66.2	T1	1.00	1.10	0.31	23.4	Yes
					T2	1.00	1.11	0.30	23.0	Yes
			Avg						23.2	
	410966	4x16	A	68.5	T1	1.00	1.06	0.25	21.7	Yes
					T2	1.00	1.09	0.22	20.2	Yes
			Avg						21.0	
	410688	5x20	A	58.1	T1	1.00	1.05	0.25	18.4	Yes
			Avg							
7175-T736	410689	2x16	A	65.4	T1	1.00	1.13	0.57	31.2	No(4,6)
					T2	1.00	1.12	0.61	32.2	No(4,6)
			Avg							
	410985	3x12	A	65.7	T1	1.00	1.10	0.39	26.1	Yes
					T2	1.00	1.09	0.35	24.7	Yes
									25.4	
	410691	4x16	A	59.9	T1	1.00	1.09	0.51	27.1	Yes
					T2	1.00	1.07	0.50	26.9	Yes
			Avg						27.0	
	410986	5x20	A	60.1	T1	1.50	1.59	0.43	29.0	Yes
					T2	1.50	1.59	0.38	27.4	Yes
			Avg						28.2	

S-L Orientation#

Alloy and Temper	Sample Number	Sample Dimensions, in.	Producer	Tensile Yield Strength, (σ_{YS}) ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5\left(\frac{K_Q}{\sigma_{YS}}\right)^2$	K_Q, ksi$\sqrt{in.}$	Valid
7049-T73	411019	2x16	A	65.4	N3	1.00	1.05	0.14	15.6	Yes
					N4	1.00	1.09	0.18	17.6	Yes
			Avg						16.6	
	410686	3x16	A	62.3	N1	1.00	1.06	0.33	22.7	Yes
					N2	1.00	1.06	0.32	22.3	Yes
			Avg						22.5	
	410966	4x16	A	67.5	N1	1.00	1.05	0.24	20.7	Yes
					N2	1.00	1.06	0.24	20.8	Yes
			Avg						20.8	
	410688	5x20	A	59.1	N1	1.00	1.05	0.28	19.7	Yes
					N2	1.00	1.05	0.28	19.8	Yes
			Avg						19.8	
7175-T736	410689	2x16	A	66.4	N1	0.75	0.83	0.39	26.3	Yes
					N2	0.75	0.84	0.39	26.3	No(4,6)
			Avg							
	410985	3x12	A	65.6	N1	1.00	1.08	0.31	23.0	Yes
					N2	1.00	1.11	0.29	22.3	No(4,6)
	410691	4x16	A	61.4	N1	1.00	1.01	0.32	22.1	Yes
					N2	1.00	1.04	0.31	21.7	Yes
			Avg						21.9	
	410986	5x20	A	58.5	N1	1.50	2.03	0.36	22.1	No(4,6,8)
					N2	1.50	1.66	0.43	24.2	No(4,6)
			Avg							

(3) Excessive yielding before crack extension; Ratio of maximum load to secant load greater than 1.1; value considered meaningful.
(4) Crack length/width (A/W) not between 0.45 and 0.55; value considered meaningful.
(6) Fatigue crack front curvature exceeded allowed amount; value considered meaningful.
(8) Stress-intensity was too high for fatigue cracking, value considered meaningful.

Refer to Fig.15 for description of orientation.

TABLE XI

RESULTS OF COMPACT-TENSION FRACTURE-TOUGHNESS TESTS OF 2124-T851 PLATE

(F33615-71-C-1571)

Number	Sample Thickness, in.	Producer	(L-T) Orientation# Tensile Yield Strength, ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5(\frac{K_Q}{\sigma_{YS}})^2$	K_Q, ksi$\sqrt{in.}$	Valid	(T-L) Orientation# Tensile Yield Strength, ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5(\frac{K_Q}{\sigma_{YS}})^2$	K_Q, ksi$\sqrt{in.}$	Valid	(S-L) Orientation# Tensile Yield Strength, ksi	Specimen Number	Specimen Thickness, in.	Crack Length, in.	$2.5(\frac{K_Q}{\sigma_{YS}})^2$	K_Q, ksi$\sqrt{in.}$	Valid
410675	1.750	A	67.0	L-1	1.50	1.58	0.45	28.3	Yes	65.7	T-1	1.50	1.56	0.33	24.0	Yes	65.3	N-1	0.50	0.49	0.22	19.5	Yes
				L-2	1.50	1.57	0.45	28.6	Yes		T-2	1.50	1.58	0.33	23.9	Yes		N-2	0.50	0.47	0.19	18.2	Yes
		Avg						28.4							24.0							18.8	
410680	2.000	C	66.2	L-1	1.50	1.56	0.53	30.4	Yes	65.4	T-1	1.50	1.54	0.35	24.4	Yes	64.9	N-1	0.75	0.74	0.22	19.1	Yes
				L-2	1.50	1.55	0.52	30.3	Yes		T-2	1.50	1.54	0.34	24.1	Yes		N-2	0.75	0.74	0.22	19.2	Yes
		Avg						30.4							24.2							19.2	
410681	2.040	B	65.4	L-1	0.75	0.75	0.26	21.1	Yes	65.2	T-1	0.75	0.74	0.22	19.5	Yes	62.7	N-1	0.75	0.73	0.20	17.6	Yes
				L-2	0.75	0.74	0.27	21.3	Yes		T-2	0.75	0.73	0.22	19.4	Yes		N-2	0.75	0.73	0.21	18.1	Yes
		Avg						21.2							19.4							17.8	
410676	2.500	A	65.4	L-1	1.00	1.01	0.44	27.3	Yes	64.2	T-1	1.00	1.04	0.42	26.3	Yes	63.5	N-1	1.00	0.96	0.29	21.8	Yes
				L-2	1.00	1.02	0.43	27.1	Yes		T-2	1.00	1.05	0.41	26.1	Yes		N-2	1.00	0.97	0.31	22.2	Yes
		Avg						27.2							26.2							22.0	
410677	3.500	A	63.9	L-1	1.50	1.51	0.61	31.6	Yes	62.7	T-1	1.50	1.55	0.44	26.4	Yes	61.4	N-1	1.00	0.99	0.43	25.4	Yes
				L-2	1.50	1.52	0.61	31.5	Yes		T-2	1.50	1.55	0.46	26.8	Yes		N-2	1.00	0.99	0.41	24.7	Yes
		Avg						31.6							26.6							25.0	
410682	4.000	B	65.5	L-1	1.50	1.56	0.30	22.5	Yes	64.2	T-1	1.50	1.59	0.27	21.0	Yes	60.2	N-1	1.50	1.56	0.27	19.9	Yes
				L-2	1.50	1.58	0.31	23.0	Yes		T-2	1.50	1.59	0.26	20.8	Yes		N-2	1.50	1.54	0.27	20.0	Yes
		Avg						22.8							20.9							20.0	
410678	4.500	A	63.4	L-1	1.50	1.54	0.46	27.2	Yes	61.4	T-1	1.50	1.57	0.36	23.3	Yes	59.8	N-1	1.50	1.53	0.36	22.7	Yes
				L-2	1.50	1.52	0.44	26.7	Yes		T-2	1.50	1.52	0.34	22.5	Yes		N-2	1.50	1.52	0.35	22.5	Yes
		Avg						27.0							22.9							22.6	
410683	4.500	C	59.8	L-1	1.50	1.53	0.76	33.1	Yes	58.5	T-1	1.50	1.64	0.58	28.2	No†	57.3	N-1	1.50	1.54	0.51	25.8	Yes
				L-2	1.50	1.51	0.71	31.9	Yes		T-2	1.50	1.57	0.51	26.5	Yes		N-2	1.50	1.54	0.47	24.9	Yes
		Avg						32.5							26.5							25.4	
410679	5.500	A	61.1	L-1	1.50	1.50	1.53	28.1	Yes	59.3	T-1	1.50	1.54	0.35	22.3	Yes	57.5	N-1	1.50	1.50	0.42	23.6	Yes
				L-2	1.50	1.50	0.55	28.8	Yes		T-2	1.50	1.51	0.34	21.8	Yes		N-2	1.50	1.47	0.43	23.9	Yes
		Avg						28.4							22.0							23.8	
410684	6.000	C	57.1	L-1	1.50	1.52	0.65	29.1	Yes	55.0	T-1	1.50	1.58	0.48	24.1	Yes	54.8	N-1	1.50	1.53	0.50	24.5	Yes
				L-2	1.50	1.55	0.67	29.7	Yes		T-2	1.50	1.56	0.46	23.7	Yes		N-2	1.50	1.53	0.50	24.5	Yes
		Avg						29.4							23.9							24.5	

† Fatigue cracking stress-intensity factor KF was greater than $0.6xK_Q$ for last stop of fatigue cracking.

Refer to Fig.15 for description of orientation.

TABLE LII

SUPPLEMENTAL COMPACT-TENSION FRACTURE TOUGHNESS DATA OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Producer	Tensile: Ultimate Strength, ksi	Tensile: Yield Strength,* ksi	Tensile: Elong in 4D, %	Fracture Toughness: Specimen Thickness in.	Fracture Toughness: Crack Length, in.	Fracture Toughness: $2.5 \left(\frac{K_Q}{\sigma_{YS}}\right)$	Fracture Toughness: K_Q, ksi$\sqrt{in.}$	Valid
			Longitudinal (L-T Orientation)#							
369722	1.570	A	70.6	65.2	11.5	1.50	1.48	0.69	34.2	Yes
						1.50	1.53	0.73	35.2	Yes
		Avg							34.7	
369724		A	71.4	64.2	10.5	1.50	1.59	0.46	27.4	Yes
						1.50	1.58	0.48	28.0	No(6)
		Avg								
369726		A	72.8	67.2	9.8	1.50	1.56	0.39	26.5	Yes
						1.50	1.56	0.37	26.0	Yes
		Avg							26.2	
410752	2.500	A	71.5	66.2	10.0	2.00	2.16	0.69	34.9	Yes
						2.00	2.15	0.65	33.7	Yes
		Avg							34.2	
410853		A	70.8	65.6	9.0	2.00	2.10	0.78	36.7	Yes
						2.00	2.10	0.77	36.4	Yes
		Avg							36.6	
410799	2.520	A	74.9	69.7	8.5	1.00	0.94	0.33	25.2	Yes
						1.00	0.96	0.35	26.0	Yes
						1.00	0.96	0.34	25.5	Yes
		Avg							25.6	
410816	3.500	A	71.0	65.4	9.0	1.50	1.54	0.44	27.9	Yes
						1.50	1.98	0.59	31.8	No(4)
		Avg								
340900	4.000	A	67.2	59.4	9.4	1.00	1.00	0.59	28.9	Yes
						1.00	1.00	0.61	29.4	Yes
		Avg							29.2	
340896	4.310	A	67.2	59.3	9.4	1.00	1.00	0.50	26.5	Yes
						1.00	0.99	0.52	27.0	Yes
		Avg							26.8	

(Continued)

TABLE LII

(CONCLUDED)

SUPPLEMENTAL COMPACT-TENSION FRACTURE TOUGHNESS DATA OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Producer		Tensile: Ultimate Strength, ksi	Tensile: Yield Strength,* ksi	Tensile: Elong in 4D, %	Fracture Toughness: Specimen Thickness, in.	Fracture Toughness: Crack Length, in.	Fracture Toughness: $2.5\left(\frac{K_Q}{\sigma_{YS}}\right)^2$	Fracture Toughness: K_Q, ksi$\sqrt{in.}$	Fracture Toughness: Valid
					Long-Transverse (T-L Orientation)						
369722	1.570	A		70.4	65.2	10.0	1.50	1.52	0.51	29.4	Yes
							1.50	1.54	0.54	30.3	Yes
			Avg							29.8	
369724		A		72.8	67.2	8.8	1.50	1.59	0.35	25.3	Yes
							1.50	1.59	0.35	25.1	Yes
			Avg							25.2	
369726		A		72.6	67.2	9.0	1.50	1.56	0.32	24.0	Yes
							1.50	1.56	0.32	24.0	Yes
			Avg							24.0	
410852	2.500	A		70.8	64.8	8.0	2.00	2.15	0.47	28.1	Yes
							2.00	2.13	0.46	27.7	Yes
			Avg							27.9	
410853		A		70.5	64.4	7.0	2.00	2.18	0.54	30.0	Yes
							2.00	2.17	0.54	29.9	Yes
			Avg							30.0	
410799	2.520	A		73.9	67.6	6.5	1.00	0.96	0.28	22.6	Yes
							1.00	0.98	0.29	23.1	Yes
			Avg							22.8	
410816	3.500	A		70.2	64.2	7.0	1.50	1.52	0.33	23.3	Yes
							1.50	1.52	0.32	22.8	Yes
			Avg							23.0	
340900	4.000	A		67.8	60.0	8.8	1.00	1.01	0.31	21.0	No(6)
							1.00	1.03	0.38	23.4	Yes
			Avg								
340896	4.310	A		68.3	60.8	8.5	1.00	1.00	0.38	23.6	Yes
							1.00	0.99	0.39	23.9	Yes
			Avg							23.8	
					Short-Transverse (S-L Orientation)						
369722	1.570	A		67.1	63.0	3.1	0.50	0.50	0.28	21.0	No(3)
							0.50	0.49	0.29	21.6	Yes
			Avg								
369724		A		69.7	65.4	3.9	0.50	0.47	0.21	18.8	Yes
369726		A		68.2	64.4	3.1	0.50	0.49	0.27	21.3	Yes
							0.50	0.50	0.25	20.5	Yes
			Avg							20.9	
410852	2.500	A		68.5	62.9	3.6	1.00	0.93	0.28	21.1	Yes
							1.00	0.93	0.28	21.2	Yes
			Avg							21.2	
410853		A		67.6	62.1	4.4	1.00	0.96	0.34	22.9	Yes
							1.00	0.94	0.31	21.8	Yes
			Avg							22.4	
410799	2.520	A		73.7	66.3	7.0	1.00	0.95	0.20	18.8	Yes
							1.00	0.97	0.24	20.6	Yes
			Avg							19.7	
410816	3.500	A		64.6	59.9	1.9	1.00	0.99	0.32	21.4	Yes
							1.00	0.99	0.27	19.8	Yes
			Avg							20.6	
340900	4.000	A		66.1	59.3	4.5	1.00	0.98	0.44	24.8	Yes
							1.00	0.98	0.38	23.1	Yes
			Avg							24.0	
340896	4.310	A		66.6	59.6	4.5	1.00	0.95	0.41	24.1	Yes
							1.00	0.97	0.42	24.5	Yes
										24.3	

(3) Excessive yielding before crack extension. Ratio of maximum load to secant load greater than 1.1; value considered meaningful.

(4) Crack length/width (A/W) not between 0.45 and 0.55.

(6) Fatigue crack front curvature exceeded allowed amount, value considered meaningful.

* Offset equals 0.2 per cent.

\# Refer to Fig.15 for description of orientation.

TABLE LIII

RESULTS OF FRACTURE-TOUGHNESS TESTS OF 16-IN. WIDE PANELS FROM 7475-T61 SHEET

(F33615-71-C-1571)

Nominal Thickness, in.	Sample Number	Specimen Number	Specimen Thickness, in.	Tensile Yield Strength, (σ_{YS}) ksi	Original Crack Length	Crack Length at Failure: Visual Method, in.	Crack Length at Failure: Compliance Method, in.	Gross Stress, (σ) ksi	Net Stress,† (σ_n) ksi	σ_n/σ_{YS} †	K_c Visual Method,# in.	Valid K_c	K_c Compliance Method,# ksi$\sqrt{in.}$	Valid K_c
							Longitudinal (L-T)							
0.040	410651	L1	0.040	76.2	4.00	4.28	5.10	30.2	40.2	0.53	81.4	Yes	90.4	Yes
	410652	L1	0.039	77.1	4.00	4.34	5.35	29.2	38.9	0.51	79.5	Yes	90.2	Yes
0.063	410653	L3	0.063	74.1	1.00	1.52	1.87	61.9	66.0	0.89	96.6	No*	107.4	No*
		L5	0.063	74.1	2.00	2.32	2.80	49.0	56.0	0.76	95.0	Yes	104.9	No*
		L2	0.063	74.1	3.00	3.46	4.10	39.8	49.0	0.66	95.4	Yes	104.9	Yes
		L7	0.063	74.1	4.00	4.32	5.10	32.6	43.5	0.59	88.6	Yes	97.9	Yes
		L4	0.063	74.1	5.00	5.40	6.55	28.4	41.3	0.56	88.2	Yes	100.8	Yes
		L6	0.063	74.1	6.00	6.60	7.75	23.6	37.8	0.51	84.3	Yes	96.1	Yes
	410654	L1	0.062	75.7	4.00	4.28	5.55	30.5	40.7	0.54	82.5	Yes	96.7	Yes
0.090	410655	L1	0.091	74.2	4.00	5.22	6.75	38.0	50.7	0.68	115.8	Yes	138.2	No*
	410656	L1	0.089	73.7	4.00	4.62	5.41	38.3	51.1	0.69	108.3	Yes	119.4	Yes
0.125	410657	L1	0.110	74.5	4.00	4.78	5.32	38.6	51.4	0.69	111.2	Yes	118.8	Yes
	410658	L1	0.125	76.8	4.00	4.90	5.13	36.2	48.2	0.63	105.8	Yes	108.8	Yes
0.188	410659	L1	0.182	75.0	4.00	6.48	5.40	36.7	49.0	0.65	129.5	No*	114.3	Yes
	410660	L1	0.186	75.6	4.00	5.90	5.00	32.9	43.9	0.58	108.6	Yes	97.5	Yes
0.249	410661	L1	0.240	75.3	4.00	5.70	5.80	40.1	53.5	0.71	129.2	No*	130.7	No*
	410662	L1	0.249	77.4	4.00	5.20	4.17	25.7	34.3	0.44	78.1	Yes	68.4	No*
							Transverse (T-L)							
0.040	410651	T1	0.040	72.9	4.00	4.52	5.35	30.3	40.4	0.55	84.5	Yes	93.7	Yes
	410652	T1	0.042	73.1	4.00	4.36	5.45	31.7	42.3	0.59	86.5	Yes	99.1	Yes
0.063	410653	T3	0.063	72.6	1.00	1.64	2.55	60.7	64.8	0.89	98.5	No*	123.7	No*
		T5	0.063	72.6	2.00	2.54	2.05	45.9	52.5	0.72	93.4	Yes	83.5	Yes
		T2	0.063	72.6	3.00	3.60	4.27	38.1	46.9	0.65	93.3	Yes	102.7	Yes
		T7	0.063	72.6	4.00	4.52	4.85	31.2	41.5	0.57	86.8	Yes	90.6	Yes
		T4	0.063	72.6	5.00	5.48	6.78	27.8	40.4	0.56	87.2	Yes	101.3	Yes
		T6	0.063	72.6	6.00	6.80	7.75	22.2	35.6	0.49	81.2	Yes	90.4	Yes
	410654	T1	0.062	73.8	4.00	4.38	5.25	29.3	39.1	0.53	80.3	Yes	89.6	Yes
0.090	410655	T1	0.091	72.1	4.00	4.88	5.40	34.3	43.8	0.64	100.2	Yes	106.8	Yes
	410656	T1	0.090	71.9	4.00	5.12	5.25	36.8	49.1	0.08	110.6	Yes	112.4	Yes
0.125	410657	T1	0.110	72.6	4.00	5.36	5.60	35.6	47.4	0.65	110.1	Yes	113.2	Yes
	410658	T1	0.126	73.1	4.00	4.94	4.60	29.7	39.6	0.54	87.2	Yes	83.6	Yes
0.188	410659	T1	0.181	72.3	4.00	5.00	5.10	30.9	41.3	0.57	91.7	Yes	92.8	Yes
	410660	T1	0.186	72.6	4.00	5.98	4.87	27.7	36.9	0.51	92.1	Yes	80.7	Yes
0.249	410661	T1	0.240	73.4	4.00	5.60	5.67	33.9	45.1	0.62	107.8	Yes	108.7	Yes
	410662	T1	0.250	75.0	4.00	5.20	4.17	25.0	33.3	0.44	73.0	Yes	65.9	Yes

* Invalid K_c; NTS based on crack length at failure > 0.80 TYS.
† Based on original crack length.
\# Calculated using the following equation:

$$K_c = \frac{Pa^{1/2}}{BW}\left[1.77 + 0.227\left(\frac{a}{W}\right) - 0.510\left(\frac{a}{W}\right)^2 + 2.7\left(\frac{a}{W}\right)^3\right]$$

Where P = load, lbs.
a = original crack length, in.
B = specimen thickness, in.
W = specimen width, in.

TABLE LIV

RESULTS OF FRACTURE TOUGHNESS TESTS OF 16-IN. WIDE PANELS FROM 7475-T761 SHEET

(F33615-71-C-1571)

Nominal Thickness, in.	Sample Number	Specimen Number	Specimen Thickness, in.	Tensile Yield Strength, (TYS) ksi	Original Crack Length in.	Crack Length at Failure: Visual Method in.	Crack Length at Failure: Compliance Method, in.	Gross Stress, (σ) ksi	Net Stress,† (σ_n) ksi	σ_n / σ_{YS} †	K_c, Visual Method,# ksi$\sqrt{in.}$	Valid K_c	K_c Compliance Method,# ksi$\sqrt{in.}$	Valid K_c
						Longitudinal (L-T)								
0.032	410888	L1	0.032	72.8	4.00	4.46	5.70	27.0	35.9	0.49	74.5	Yes	86.8	Yes
0.040	410663	L1	0.041	73.7	4.00	4.64	5.82	31.1	41.5	0.56	88.0	Yes	101.6	Yes
	410664	L1	0.041	74.3	4.00	4.44	5.46	29.6	39.4	0.53	81.6	Yes	92.6	Yes
0.063	410665	L3	0.062	70.5	1.00	1.66	2.70	61.4	65.5	0.93	100.2	No*	128.9	No*
		L5	0.062	70.5	2.00	2.48	2.95	49.7	56.8	0.81	99.8	Yes	109.3	No*
		L2	0.061	70.5	3.00	3.52	4.50	40.2	49.5	0.70	97.3	Yes	111.8	Yes
		L7	0.061	70.5	4.00	4.88	5.50	33.9	45.2	0.64	98.9	Yes	106.6	Yes
		L4	0.061	70.5	5.00	5.74	7.45	27.4	39.8	0.56	88.5	Yes	107.6	Yes
		L6	0.062	70.5	6.00	6.80	8.10	24.4	39.0	0.55	89.1	Yes	103.3	Yes
	410666	L1	0.061	66.4	4.00	4.72	5.90	35.7	47.5	0.72	102.0	Yes	112.5	Yes
0.090	410667	L1	0.091	67.3	4.00	5.24	6.88	38.9	51.9	0.77	118.8	No*	143.6	No*
	410668	L1	0.089	69.8	4.00	4.90	6.05	39.7	53.0	0.76	116.3	No*	133.3	No*
0.125	410669	L1	0.125	66.4	4.00	5.30	6.65	41.2	55.0	0.83	126.7	No*	148.2	No*
	410670	L1	0.125	66.8	4.00	5.24	5.65	39.8	53.0	0.79	121.2	No*	127.3	No*
0.188	410671	L1	0.185	66.4	4.00	6.00	6.90	40.2	56.0	0.84	140.2	No*	155.3	No*
	410672	L1	0.192	69.3	4.00	5.88	6.45	46.2	61.5	0.89	151.8	No*	162.1	No*
0.249	410673	L1	0.245	67.0	4.00	5.12	5.60	42.7	57.0	0.85	128.5	No*	136.0	No*
	410674	L1	0.249	67.8	4.00	5.22	4.97	27.9	37.1	0.55	84.8	Yes	82.2	Yes
						Transverse (T-L)								
0.032	410888	T1	0.032	69.4	4.00	4.84	6.00	29.7	39.6	0.57	86.2	Yes	99.0	Yes
0.040	410663	T1	0.041	70.8	4.00	4.42	5.50	30.6	40.9	0.58	84.3	Yes	96.4	Yes
	410664	T1	0.042	71.1	4.00	4.42	5.46	32.4	43.3	0.61	89.3	Yes	101.6	Yes
0.063	410665	T3	0.061	69.0	1.00	1.52	2.70	61.0	65.1	0.94	95.1	No	128.0	No*
		T5	0.062	69.0	2.00	2.50	3.16	50.8	58.1	0.84	102.4	No	116.0	No*
		T2	0.061	69.0	3.00	3.46	4.30	40.5	49.8	0.72	97.0	Yes	109.6	No*
		T7	0.062	69.0	4.00	4.72	5.90	34.1	45.5	0.66	97.6	Yes	112.5	Yes
		T4	0.062	69.0	5.00	5.84	7.25	28.1	40.8	0.59	91.9	Yes	107.9	Yes
		T6	0.063	69.0	6.00	6.80	8.10	24.6	39.4	0.57	89.9	Yes	104.2	Yes
	410666	T1	0.062	65.0	4.00	4.56	5.78	33.1	44.1	0.68	92.7	Yes	107.5	Yes
0.090	410667	T1	0.090	64.6	4.00	4.92	6.17	36.6	48.8	0.76	107.3	No	124.5	No*
	410668	T1	0.089	68.3	4.00	4.66	5.25	37.2	49.6	0.73	105.6	Yes	113.7	No*
0.125	410669	T1	0.125	64.9	4.00	5.24	5.85	37.4	49.9	0.77	114.1	No	122.6	No*
	410670	T1	0.125	65.6	4.00	5.24	5.42	35.2	47.0	0.72	107.5	Yes	109.9	No*
0.188	410671	T1	0.185	65.3	4.00	5.66	6.25	39.8	53.1	0.81	127.6	No	136.6	No*
	410672	T1	0.193	67.0	4.00	6.10	5.70	38.5	51.4	0.77	130.0	No	124.1	No*
0.249	410673	T1	0.245	65.9	4.00	5.66	6.28	40.6	54.1	0.82	130.1	No	139.7	No*
	410674	T1	0.249	68.3	4.00	5.08	4.55	25.6	34.1	0.50	76.6	Yes	71.6	Yes

* Invalid K_c; NTS based on crack length at failure > 0.80 TYS.
† Based on original crack length.
\# Calculated using the following equation:

$$K_c = \frac{Pa^{1/2}}{BW}\left[1.77 + 0.227\left(\frac{a}{W}\right) - 0.510\left(\frac{a}{W}\right)^2 + 2.7\left(\frac{a}{W}\right)^3\right]$$

Where P = load, lbs.
a = original crack length, in.
B = specimen thickness, in.
W = specimen width, in.

TABLE LV

RESULTS OF SUPPLEMENTAL FRACTURE-TOUGHNESS TESTS OF 16-IN. WIDE PANELS FROM ALCLAD 7475-T61 SHEET

(F33615-71-C-1571)

Nominal Thickness, in.	Sample Number	Specimen Number	Specimen Thickness, in.	Tensile Yield Strength, (TYS) ksi	Original Crack Length, in.	Crack Length at Failure: Visual Method, in.	Crack Length at Failure: Compliance Method, in.	Gross Stress (σ) ksi	Net Stress,† (σ_n) ksi	σ_n / σ_{YS} †	K_c Visual Method,# ksi$\sqrt{\text{in.}}$	Valid K_c	K_c Compliance Method,# ksi$\sqrt{\text{in.}}$	Valid K_c
						Longitudinal (L-T)								
0.063	369616	L3	0.064	69.3	1.00	1.93	2.64	58.0	61.8	0.89	102.2	No*	120.3	No*
		L4	0.064	69.3	3.00	4.07	4.07	37.3	46.0	0.66	97.9	Yes	97.9	Yes
		L5	0.064	69.3	4.00	5.30	5.65	32.7	43.6	0.63	100.5	Yes	104.7	Yes
		L6	0.064	69.3	4.00	4.10	5.82	31.5	42.1	0.61	83.0	Yes	103.0	Yes
		L7	0.064	69.3	6.00	7.50	7.13	22.8	36.7	0.53	90.5	Yes	86.8	Yes
	369617	L3	0.063	71.8	1.00	1.50	1.77	56.7	60.5	0.84	87.9	No*	95.7	No*
		L4	0.063	71.8	3.00	3.32	3.43	31.2	38.5	0.54	73.1	Yes	74.4	Yes
		L5	0.063	71.8	4.00	4.55	5.48	30.1	40.1	0.56	84.2	Yes	94.5	Yes
		L6	0.063	71.8	4.00	4.28	4.74	26.9	35.9	0.50	72.6	Yes	77.1	Yes
		L7	0.063	71.8	6.00	6.25	6.75	20.0	32.0	0.45	68.7	Yes	72.8	Yes
0.090	369619	L5	0.089	73.9	4.00	4.72	4.98	32.1	42.9	0.58	91.9	Yes	94.9	Yes
		L6	0.089	73.9	4.00	4.72	5.10	33.6	44.9	0.61	96.2	Yes	100.9	Yes
						Transverse (T-L)								
0.063	369616	T3	0.064	66.5	1.00	1.78	2.63	57.3	61.2	0.92	96.9	No*	118.7	No*
		T4	0.064	66.5	3.00	3.68	4.50	37.4	46.1	0.69	92.7	Yes	104.0	Yes
		T5	0.064	66.5	4.00	5.08	5.96	31.2	41.8	0.63	93.5	Yes	103.9	Yes
		T6	0.064	66.5	4.00	5.08	5.86	31.5	42.1	0.63	94.3	Yes	103.5	Yes
		T7	0.064	66.5	6.00	7.15	7.18	23.2	37.3	0.56	88.5	Yes	88.8	Yes
	369617	T3	0.063	68.4	1.00	1.35	2.07	55.8	59.4	0.87	81.9	No*	101.9	No*
		T4	0.063	68.4	3.00	3.52	4.60	36.5	45.0	0.66	88.3	Yes	102.8	Yes
		T5	0.063	68.4	4.00	4.50	5.35	28.0	37.5	0.55	78.0	Yes	86.7	Yes
		T6	0.063	68.4	4.00	4.38	5.13	29.8	39.8	0.58	81.5	Yes	89.7	Yes
		T7	0.063	68.4	6.00	6.35	6.89	21.5	34.4	0.50	74.6	Yes	79.4	Yes
0.090	369619	T5	0.090	71.5	4.00	4.27	4.27	27.9	37.2	0.52	75.4	Yes	75.4	Yes
		T6	0.089	71.5	4.00	4.52	4.10	29.7	39.7	0.55	82.9	Yes	78.3	Yes

* Invalid Kc; NTS based on crack length at failure>0.80 TYS.
† Based on original crack length.
\# Calculated using the following equation:

$$K_c = \frac{Pa^{1/2}}{BW}\left[1.77 + 0.227\left(\frac{a}{W}\right) - 0.510\left(\frac{a}{W}\right)^2 + 2.7\left(\frac{a}{W}\right)^3\right]$$

Where P = load, lbs.
a = original crack length, in.
B = specimen thickness, in.
W = specimen width, in.

TABLE LVI

RESULTS OF LONGITUDINAL SMOOTH AND NOTCHED (K_t=3) AXIAL-STRESS FATIGUE TESTS OF 7049-T73 DIE FORGINGS (R=0.0)

(F33615-71-C-1571)

Sample Number	Sample Thickness Range, in.	Die No.	Producer	Cycles to Failure, Maximum Stress, ksi: 70.0 (Smooth)	55.0 (Smooth)	42.0 (Smooth)	25.0 (Notched)	16.0 (Notched)	13.0 (Notched)
410693	≤1.000	9078	A	--	57 400	--	--	17 332 900	--
410698	1.001-2.000	15789	A	15 900	--	--	25 100	--	--
410694		B5786	B	7 900	38 500	70 300	17 000	28 964 400#	19 364 300#
410697A		40005	A	--	59 200	--	--	261 500	--
410697C		40005	A	--	49 400	--	--	271 200	--
410695	2.001-3.000	40006	A	--	67 900	--	--	594 700	--
410696		B6204	B	6 900	38 000	261 300	29 600	247 500	36 698 400#
410697B		40005	A	17 400	50 300	164 400	27 900	552 800	10 696 800#
410700	4.001-5.000	B2362	A	9 700	29 200	36 900*	20 800	127 000	13 797 800#
		Log Mean Life		10 800	47 200	144 200	23 600		

Did not fail.
* Equipment malfunction, value not reliable.

TABLE LVII

RESULTS OF LONGITUDINAL SMOOTH AND NOTCHED (K_t=3) AXIAL-STRESS FATIGUE TESTS OF 7175-T736 DIE FORGINGS (R=0.0)

(F33615-71-C-1571)

Sample Number	Sample Thickness Range, in.	Die No.	Producer	Cycles to Failure, Maximum Stress, ksi: 70.0	55.0	42.0	25.0	16.0	13.0
				Smooth			Notched		
410983	1.000	9078	A	--	57 400	--	--	149 900	--
410699	1.001-2.000	15789	A	13 100	--	--	19 300	--	--
410704		F17961	A	13 700	156 500	6 960 200	24 400	161 900	61 812 900#
410705A		40005	A	--	54 800	--	--	47 204 800#	--
410705C		40005	A	--	71 300	--	--	1 476 000	--
410706		F17976	A	14 300	80 700	142 300	22 700	122 800	69 848 200#
410705B	2.001-3.000	40005	A	19 100	91 100	6 206 500	30 000	19 439 900	42 209 100#
410984		40006	A	--	41 900	--	--	67 420 800	--
	Lot Mean Life			14 900	72 800	1 831 900	23 800		

Did not fail.

TABLE LVIII

RESULTS OF SMOOTH AND NOTCHED (K_t=3) AXIAL-STRESS FATIGUE TESTS OF 7049-T73 AND 7175-T736 HAND FORGINGS(R=0.0)

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Dimensions, in.	Producer	Smooth, Longitudinal, Cycles to Failure, 65.0	55.0	40.0	Smooth, Long Transverse, Cycles to Failure, 65.0	55.0	40.0	Notched, Longitudinal, Cycles to Failure, 25.0	16.0	13.0	Notched, Long Transverse, Cycles to Failure, 25.0	16.0	13.0
				Maximum Stress, ksi											
7049-T73	411019	2x16	A	6 300	26 500	2 299 400	5 500	33 600	100 400	14 800	148 500	11 281 100	12 300	153 900	531 100#
	410686	3x16	A	17 000	41 100	682 600	9 900	30 800	163 900	31 400	15 671 000#	13 028 300#	28 500	11 492 300#	11 251 900#
	410966	4x16	A	20 400	60 800	20 972 100	5 400	18 900	68 600	39 800	18 073 600#	13 235 700#	18 100	2 155 900	559 600
	410688	5x20	A	6 100	28 300	1 372 100	4 900	16 000	58 900	23 900	136 500	12 958 200#	24 400	139 100	237 800
	Log Mean Life			10 700	37 000	2 592 400	6 200	23 700	90 300	25 800			20 800		
7175-T736	410689	2x16	A	16 000	53 900	12 459 900	15 300	69 200	187 900	30 500	10 954 300#	15 732 100#	30 600	208 700	15 530 100#
	410985	3x12	A	11 400	49 600	686 500	9 500	36 500	9 700 400	16 300	817 800	44 571 800#	29 300	13 287 000#	10 894 600#
	410691	4x16	A	9 100	39 400	8 395 000	7 800	25 600	5 973 300	34 600	2 432 600	10 945 400#	23 700	203 600	26 071 600#
	410986	5x20	A	7 500	39 000	368 500	5 100	25 300	5 076 100	28 700	13 058 200#	15 875 700#	35 000	15 945 800#	13 504 800#
	Log Mean Life			10 600	45 000	2 268 000	8 700	35 800	3 878 000	26 500			29 400		

\# Did not fail.

TABLE LIX

RESULTS OF SMOOTH AND NOTCHED (K_t=3) AXIAL-STRESS FATIGUE TESTS OF 7475-T61 SHEET (R=0.0)

(F33615-71-C-1571)

Sample			Smooth						Notched					
			Longitudinal Cycles to Failure			Transverse Cycles to Failure			Longitudinal Cycles to Failure			Transverse Cycles to Failure		
			Maximum Stress, ksi											
Number	Thickness in.	Producer	70.0	40.0	35.0	70.0	40.0	35.0	35.0	25.0	5.0	35.0	25.0	15.0
410651	0.040	A	--	1 155 000*	--	--	82 400	--	--	44 900	--	--	38 000	--
410652		A	12 300	249 700	5 046 700	12 700	145 700*	111 300	7 700	44 400	7 977 200	7 600	44 700	39 013 700#
410653	0.063	A	--	189 200	--	--	229 900	--	--	25 400	--	--	23 300	--
410654		A	12 800	255 000	16 155 700	11 600	665 400	6 611 700	9 100	34 300	668 000	8 000	37 100	228 300
410655	0.090	A	--	151 700	--	--	111 700	--	--	36 000	--	--	41 800	--
410656		A	9 200	253 000	10 699 800	9 800	39 917 800	14 537 100	7 300	32 400	26 280 700	7 600	72 200	13 413 000#
410657	0.125	A	--	391 500	--	--	228 800	--	--	24 900	--	--	28 800	--
410658		A	14 100	189 800	5 541 500	13 800	534 100	10 501 700	6 600	50 900	32 409 400	7 600	57 200	235 800
410659	0.188	A	--	2 934 700	--	--	4 976 500	--	--	24 100	--	--	36 500	--
410660		A	19 200	7 769 700	4 104 200	23 800	1 406 300	15 974 400#	9 800	35 600	241 800	8 600	42 300	209 600
410661	0.249	A	--	2 206 800	--	--	30 864 100	--	--	38 800	--	--	23 400	--
410662		A	17 700	25 415 300	62 575 100#	17 000	50 054 200#	52 168 000#	7 000	20 400	140 900	6 600	31 100	601 400
	Log Mean Life		13 800	780 000		14 200			7 800	33 200	2 316 700	7 600	37 700	

* Failed at grip end.
\# Did not fail.

TABLE LX

RESULTS OF SMOOTH AND NOTCHED (K_t=3) AXIAL STRESS FATIGUE TESTS OF 7475-T761 SHEET (R=0.0)

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Producer	Smooth Longitudinal Cycles To Failure 70.0	Smooth Longitudinal Cycles To Failure 40.0	Smooth Longitudinal Cycles To Failure 35.0	Smooth Transverse Cycles To Failure 70.0	Smooth Transverse Cycles To Failure 40.0	Smooth Transverse Cycles To Failure 35.0	Notched Longitudinal Cycles To Failure 35.0	Notched Longitudinal Cycles To Failure 25.0	Notched Longitudinal Cycles To Failure 15.0	Notched Transverse Cycles To Failure 35.0	Notched Transverse Cycles To Failure 25.0	Notched Transverse Cycles To Failure 15.0
			Maximum Stress, ksi											
410888	0.032	A	17 700	119 800	988 600*	14 900	97 300	832 600*	6 800	26 400	636 000	4 900	17 900	10 970 900#
410663	0.040	A	--	190 700*	--	--	38 700	--	--	27 000	--	--	28 700	--
410664		A	10 100	1 745 800	1 366 300	13 900	76 600	140 800	7 900	26 000	9 866 800	5 800	34 400	5 529 900
410665	0.063	A	--	238 900	--	--	102 000	-- #	--	15 900	--	--	22 100	--
410666		A	9 100	202 000	13 240 600	7 600	260 600	15 621 100	6 900	22 900	6 045 700	7 400	22 000	17 724 900#
410667	0.090	A	--	111 800	--	--	127 400	--	--	22 700	-- #	--	23 500	-- #
410668		A	6 600	241 900	6 051 700	11 100	217 500	206 600	8 700	30 500	17 530 700	7 700	36 100	13 331 200
410669	0.125	A	--	3 401 500	--	--	431 000	--	--	22 300	--	--	28 000	--
410670		A	7 800	156 200	370 200	6 100	215 200	5 897 800	7 200	31 100	219 700	8 000	23 400	2 503 700
410671	0.188	A	--	7 257 500	---	--	26 303 600	--	--	28 300	--	--	22 000	--
410672		A	6 100	285 300x	21 900 500	8 800	22 448 500	31 494 100#	6 200	29 200	243 900	6 900	37 500	115 800
410673	0.249	A	--	12 746 000	--	--	29 940 300#	--	--	22 000	--	--	33 600	--
410674		A	9 700	306 600	104 448 800#	12 600	63 158 400	70 076 900#	5 700	25 500	126 500	6 100	23 800	1 011 200
Log Mean Life			9 000	523 900		10 200			7 000	25 000		6 600	26 500	

* Failed at grip end
\# Did not fail.
x Failed 1" from center.

TABLE LXI

RESULTS OF SMOOTH AND NOTCHED AXIAL-STRESS FATIGUE TESTS OF 2124-T851 PLATE (R=0.0)

(F33615-71-C-1571)

Sample			Smooth						Notched					
			Longitudinal			Long-Transverse			Longitudinal			Long-Transverse		
			Cycles to Failure			Cycles to Failure			Cycles to Failure			Cycles to Failure		
			Maximum Stress, ksi											
Number	Thickness, in.	Producer	60.0	40.0	24.0	60.0	40.0	24.0	40.0	20.0	11.0	40.0	20.0	11.0
410675	1.750	A	--	62 600	--	--	90 800	--	--	39 000	--	--	34 500	--
410680	2.000	C	17 100	90 300	883 300	18 400	97 200	40 156 700	5 400	39 900	799 300	5 400	47 000	37 523 600#
410681	2.040	B	14 000	87 200	22 653 000	18 700	120 800	65 002 700#	4 700	36 000	639 200	4 300	33 000	20 744 100
410676	2.500	A	--	72 900	--	--	79 500	--	--	42 900	--	--	45 500	--
410677	3.500	A	--	68 500	--	--	95 800	--	--	34 400	--	--	40 400	--
410682	4.000	B	13 500	66 400	30 987 100#	11 600	85 800	83 202 500#	4 600	35 900	393 400	3 600	36 300	494 900
410678	4.500	A	--	76 700	--	--	57 200	--	--	33 400	--	--	33 900	--
410683	4.500	C	14 500	78 400	33 586 900	11 400	106 700	76 317 200#	5 500	40 400	992 500	5 700	45 100	4 167 900
410679	5.500	A	--	71 300	--	--	86 000	--	--	34 900	--	--	35 600	--
410684	6.000	C	8 900	74 600	931 400	7 800	106 600	89 496 000#	5 000	39 400	359 500	4 200	39 800	452 300
	Log Mean Life		13 300	74 400		12 900	90 400		5 000	35 000	590 400	4 600	38 800	

\# Specimen did not fail.

TABLE LXII

RESULTS OF SMOOTH AND NOTCHED (K_t=3) AXIAL-STRESS FATIGUE TESTS OF 7049-T73 AND 7175-T736 HAND FORGINGS AND 2124-T851 PLATE IN SALT FOG

(F33615-71-C-1571)

7049-T73 HAND FORGING				7175-T736 HAND FORGING				2124-T851 PLATE			
410966 (4x16-in.)		410688 (5x20-in.)		410691 (4x16-in.)		410986 (5x20-in.)		410680 (2-in.)		410683 (4-1/2-in.)	
Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure
SMOOTH SPECIMENS											
40.2	96,000	40.0	273,000+	40.0	76,900	40.0	314,300*	40.1	78,000	40.0	68,400
24.0	573,000*	24.0	2,865,300*+	30.0	1,223,000	30.1	334,600*	24.0	1,403,200	31.9	212,000
24.0	903,000*+	24.0	3,968,700+	24.0	4,694,600*	25.9	539,500	20.0	14,250,800	24.0	410,200
NOTCHED SPECIMENS											
20.0	17,400	20.0	17,200+	20.0	14,600	20.0	19,500	20.0	22,700	20.0	18,100
13.0	70,500	13.0	473,400	13.0	55,700	13.0	96,600	11.0	2,387,300	11.0	504,600
11.0	2,621,700*	11.0	7,922,400*	11.0	80,600	11.0	171,500	9.0	13,362,800	7.0	3,842,500

Notes: Long-Transverse 0.30' Dia. Specimens (Fig. 20); R = 0.0, f = 18.3 Hz

*Failed in grip end.

+Fractographic examination(SEM) did not reveal any characteristics of stress corrosion cracking.

Table LXIII

RESULTS OF SMOOTH AND NOTCHED (K_t=3) AXIAL-STRESS FATIGUE TESTS OF 7475-T61 AND T761 SHEET IN SALT FOG

(F33615-71-C-1571)

7475-T61				7475-T761			
410652 (0.040-in.)		410658 (0.125-in.)		410664 (0.040-in.)		410670 (0.125-in.)	
Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure	Max. Stress, ksi	Cycles to Failure
Smooth Specimens							
39.9	36,200	40.0	62,500	39.9	29,600	40.1	51,000
24.0	294,800	28.0	434,500	24.0	213,300	28.0	1,276,800
19.9	545,200	24.0	2,186,300	20.0	1,276,700*	24.0	2,010,200
Notched Specimens							
20.0	20,700	20.0	19,700	20.0	19,600	40.0	2,200
13.0	472,500	15.0	327,800	13.0	583,600	20.0	56,400
10.0	3,757,300	13.0	1,375,100	10.1	3,530,300	13.0	1,771,500

Notes: Long-transverse sheet type specimens (Fig. 21); R = 0.0, f = 18.3 Hz.

* Failed in grip end.

Table LXIV

RATES OF FATIGUE CRACK PROPAGATION
Constant Load Tests
(F33615-71-C-1571)

Alloy and Temper	Product	Sample Size	Sample No.	Orientation	Specimen Type	Data Shown in Figs.	da/dN at indicated ΔK,* micro-in./cycle: Dry Air 7	Dry Air 12	Humid Air+ 7	Humid Air+ 12	Salt Fog+ 7	Salt Fog+ 12
7049-T73	Hand Forging	4x16	410966	T-L	CT	72	5.5	130	10	150	11	150
		5x20	410688	T-L	CT	73	4.0	140	10	160	-	-
		"	"	T-L	CN	74	5.5	80	7.5	95	12	100
		"	"	L-T	CN	75	4.0	23	6.5	32	12	38
		"	"	S-T	CT	76	3.0	70	0.3	19		
7175-T736	Hand Forging	4x16	410691	T-L	CT	77	4.0	35	7.0	40	9	35
		5x20	410986	T-L	CT	78	3.5	24	7.0	40	8	36
		"	"	T-L	CN	79	5.0	35	6.5	40	10	50
		"	"	L-T	CN	80	5.0	28	6.5	35	13	70
		"	"	S-T	CT	81	1.5	32	1.4	40	1.4	30
7475-T61	Sheet	0.040	410652	T-L	CN	82	3.5	14	8.5	38	11	42
		0.125	410658	T-L	CN	83	4.0	20	8.5	48	14	75
			"	L-T	CN	84	3.0	17	10	55	14	70
7475-T761	Sheet	0.040	410664	T-L	CN	85	3.0	24	6.5	35	15	50
		0.125	410670	T-L	CN	86	3.5	20	5.5	32	12	65
			"	L-T	CN	87	3.0	15	5.0	32	14	55
2124-T851	Plate	2"	410680	T-L	CN	88	3.5	24	4.0	28	6	35
		4.5"	410683	T-L	CN	89	2.5	12	4.0	25	3	28
			"	L-T	CN	90	1.5	7	3.0	15	4	18
			"	S-L	CT	91	3.0	28	3.5	34	3.5	28

* ksi $\sqrt{in.}$
\+ indicates time of exposure in tests.
R = +1/3; f = 5.2 to 13.3 Hz

TABLE LXV

SYSTEM FOR VISUAL RATING OF EXFOLIATION CORROSION
CONTAINED IN ASTM METHOD G34-72

(F33615-71-C-1571)

Code	Classification and Specimen Condition
N	No appreciable attack. Surface may be etched or discolored.
P or P-A,B or C	Pitting. Includes discrete pitting or pit-blistering In the latter case, attack results in a slight under-cutting of the surface, and can occur in varying degrees of severity. The degree of severity of pit-blistering should be indicated by addition of one of the letters A, B or C (increasing order of severity).
E- A,B,C or D	Exfoliation. Visible lifting of the surface. A range of exfoliation can occur of varying degrees of severity. The degree of severity of exfoliation should be indicated by addition of one of the letters A, B, C or D (increasing order of severity). An example of the four degrees of severity). An example of the four degrees of severity is shown in Figure .

TABLE LXVI

RESULTS OF ACCELERATED EXFOLIATION TESTS ON 7049-T73 FORGINGS (F33615-71-C-1571)

Sample			Visual Rating*	
Number	Thickness or Dimensions, in.	Producer	EXCO	Salt Spray
	PART A - Die Forgings			
410693	≤1.000	A	P	--
410693	≤1.000	A	P(T/2)	--
410698**	1.001-2.000	A	P	E-A
410698		A	E-A(T/2)	--
410697	2.001-3.000	A	P	--
410695		A	P	--
410694	1.001-2.000	B	P	--
410696	2.001-3.000	B	P	--
410700	4.001-5.000	B	P	--
	PART B - Hand Forgings			
411019**	2x16	A	P	P
410686	3x16	A	E-A	--
410966	4x16	A	P	--
410688*	5x20	A	E-B	E-A

NOTE: All test specimens were T/10 panels except those noted to be T/2.

* ASTM Method G34-72 (See Table LXV, Fig. 92)

** T/10 panel from this item also exposed to seacoast atmosphere.

TABLE LXVII

RESULTS OF ACCELERATED EXFOLIATION TESTS ON 7175-T736 FORGINGS

(F33615-71-C-1571)

Sample			Visual Rating*	
Number	Thickness or Dimensions, in.	Producer	EXCO	Salt Spray
	PART A - Die Forgings			
410983	≤1.000	A	P	--
410983	≤1.000	A	P(T/2)	--
410699**	1.001-2.000	A	P	E-A
410699		A	P(T/2)	--
410704		A	P	--
410706		A	P	--
410705	2.001-3.000	A	P	--
410984		A	P	--
	PART B - Hand Forgings			
410689**	2x16	A	P	P
410985	3x12	A	P	--
410691	4x16	A	P	--
410986**	5x20	A	P	P

NOTE: All test specimens were T/10 panels except those noted to be T/2.

* ASTM Method G34-72 (See Table LXV , Fig. 92).

** T/10 panel from this item also exposed to seacoast atmosphere.

TABLE LXVIII

RESULTS OF ACCELERATED EXFOLIATION TESTS ON 7475 SHEET (F33615-71-C-1571)

Sample Number	Sample Thickness,	Producer	Visual Rating* EXCO	Visual Rating* Salt Spray+
		PART A - 7475-T61		
410651	0.040	A	E-A	P
410652	0.040	A	E-A	--
410653	0.063	A	E-A	P
410654	0.063	A	E-A	--
410655	0.090	A	E-A	P,E-A‡
410656	0.090	A	E-A	--,E-A‡
410657	0.125	A	E-A	P
410658	0.125	A	E-C	--,E-C‡
410659	0.188	A	E-A	P
410660	0.188	A	E-A	--
410661	0.249	A	E-A	P
410662	0.249	A	E-A	--
		PART B - 7475-T761		
410663	0.040	A	P	P
410664	0.040	A	P	--
410665	0.063	A	P	P
410666	0.063	A	P	--
410667	0.090	A	P	P
410668	0.090	A	P	--
410669	0.125	A	P	P
410670	0.125	A	P	--
410671	0.188	A	P	P
410672	0.188	A	P	--
410673	0.249	A	P	P
410674	0.249	A	P	--

NOTE: T/10 panels used in all tests.

* ASTM Method G34-72; see Table LXV, Fig. 92.

\+ Lots exposed to salt spray were also exposed to seacoast atmosphere.

‡ Retest

TABLE LXIX

RESULTS OF ACCELERATED EXFOLIATION TESTS ON 2124-T851 PLATE

(F33615-71-C-1571)

Sample			Visual Rating*		
			EXCO+,‡		
Number	Thickness, in.	Product**	1	2	Salt Spray‡‡
410675	1.75	A	P	P	P
410680	2.00	C	P	P	--
410681	2.04	B	P	P	--
410676	2.50	A	P	P	P
410677	3.50	A	P	P	P
410682	4.00	B	P	P	--
410678	4.50	A	P	P	P
410683	4.50	C	P	P	--
410679	5.50	A	P	P	P
410684	6.00	C	P	P	--

NOTE: All test specimens were T/10 panels.

* ASTM Method G34-72 (See Table LXV)

** Lots fabricated by Producer A were also exposed to seacoast atmosphere.

\+ Specimens tested from opposite ends of samples.

‡ Tested for 144 hrs rather than the 48 hr period specified for 7XXX series alloys.

‡‡ Tested for 2 weeks rather than the 1 week period specified for 7XXX series alloys.

TABLE LXX

RESULTS OF LONGITUDINAL AND LONG-TRANSVERSE ACCELERATED SCC TESTS ON 7049-T73 AND 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Sample				Original Tensile Properties			% Loss in Tensile Strength		SCC Data Stressed 75% of Yield Strength	
Number	Thickness, in.	Direction*	Producer	Ultimate Strength, ksi	Yield Strength, ksi	Elong, %	Unstressed	75% Y.S.	F/N	Days
				PART A - 7049-T73						
410693	≤1.000	L	A	79.2	69.7	13.0	13	46	0/3	3 OK 84
410698	1.001-2.000		A	78.7	72.2	14.0	19	19	0/3	3 OK 84
410693	≤1.000	LT	A	73.8	63.4	10.0	11	32	0/3	3 OK 84
410698	1.001-2.000		A	80.3	73.3	13.0	20	23	0/3	3 OK 84
				PART B - 7175-T736						
410983	≤1.000	L	A	81.2	73.9	14.0	11	55	0/3	3 OK 84
410699	1.001-2.000		A	83.0	76.2	12.0	16	27	0/3	3 OK 84
410983	≤1.000	LT	A	80.1	71.0	14.0	16	53	0/3	3 OK 84
410699	1.001-2.000		A	80.4	72.7	12.0	17	32	0/3	3 OK 84

NOTE: 0.125-in. dia. tensile specimens exposed 84 days to 3.5% NaCl-AI per Federal Method 823.

* L-Longitudinal; LT-Long-Transverse.
† F/N denotes number of specimens failed over number exposed.

TABLE LXXI

RESULTS OF SHORT-TRANSVERSE ACCELERATED SCC TESTS ON 7049-T73 AND 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Producer	Test Location	Conductivity % IACS	Original Tensile Properties: Ultimate Strength, ksi	Original Tensile Properties: Yield Strength, ksi	Original Tensile Properties: Elong, %	% Loss in Tensile Strength: Unstressed	% Loss in Tensile Strength: Stressed 45 ksi	% Loss in Tensile Strength: Stressed 35 ksi	% Loss in Tensile Strength: Stressed 25 ksi	SCC Data: Stressed 45 ksi F/N†	SCC Data: Stressed 45 ksi Days	SCC Data: Stressed 35 ksi F/N†	SCC Data: Stressed 35 ksi Days	SCC Data: Stressed 25 ksi F/N†	SCC Data: Stressed 25 ksi Days
PART A - 7049-T73																	
410693	≤1.000	A	3/16" from flash	--	73.1	63.4	8.0	17	45	37	--	0/3	3 OK 84	0/3	3-OK84	--	--
410693		A	3/8" from flash	41.5	72.0	62.1	6.0	19	--	89	--	3/3	39,47,51	2/3	30,64,OK84	--	--
410698	1.001-2.000	A	3/16" from flash	--	79.6	74.4	4.0	26	--	--	--	3/3	21,25,34	3/3	37,49,62	--	--
410698		A	3/8" from flash	38.2	80.2	72.8	8.0	34	--	--	--	3/3	18,31,31	3/3	41,57,56	--	--
410698•		A	3/8" from flash	--	--	--	--	--	--	--	--	3/3	38,57,62	--	--	--	--
410694		B	3/8" from flash	39.0	77.3	68.7	5.0	37	--	--	--	3/3	38,44,60	3/3	53,53,73	--	--
410695	2.001-3.000	A	5/8" from flash	41.5	73.7	66.3	6.0	28	--	46	--	3/3	32,38,44	2/3	57,80,OK84	--	--
410700	4.001-5.000	B	3/8" from flash	38.0	78.4	76.3	2.0	21	40	24	--	2/3	17,32,OK84	0/3	3-OK 84	--	--
410700•		B	3/8" from flash	--	--	--	--	--	--	--	--	3/3	34,44,45	--	--	--	--
410696‡	2.001-3.000	B	Perpendicular	41.1	76.0	67.1	9.0	13	18	--	--	0/3	3-OK 84	--	--	--	--
410697‡		A	Perpendicular	40.4	74.8	67.2	10.0	19	28	--	--	0/3	3-OK 84	--	--	--	--
410697‡#		A	3/8" from flash	--	--	--	--	--	--	--	--	0/3	3-OK 84	0/3	3-OK 84	--	--
PART B - 7175-T736																	
410983	≤1.000	A	3/16" from flash	--	74.9	64.3	8.0	14	--	--	83	3/3	45,46,51	2/3	56,75,1-OK84	1/3	65,2-OK84
410983		A	3/8" from flash	40.3	74.1	63.3	9.0	20	--	--	35	3/3	42,45,53	3/3	57,57,60	1/3	84,2-OK84
410699	1.001-2.000	A	3/16" from flash	--	77.6	69.5	8.0	25	--	--	36	3/3	28,31,37	3/3	42,42,44	0/3	3-OK 84
410699		A	3/8" from flash	38.5	75.6	68.3	8.0	26	--	57	57	3/3	39,63,72	2/3	58,73,OK84	0/3	3-OK 84
410706		A	3/8" from flash	39.4	76.6	67.9	8.0	20	--	74	39	3/3	37,49,55	2/3	43,57,OK84	0/3	3-OK 84
410984	2.001-3.000	A	5/8" from flash	40.4				38	--	--	68	3/3	46,50,55	3/3	56,65,84	0/3	OK84
410704‡	1.001-2.000	A	Perpendicular	40.1	75.7	66.7	8.0	15	--	52	--	3/3	44,77,84	0/3	3-OK 84	--	--
410705‡	2.001-3.000	A	Perpendicular	39.7	76.3	68.4	12.0	18	93	27	--	2/3	61,64,OK84	0/3	3-OK 84	--	--
410705‡#		A	3/8" from flash	--	--	--	---	--	--	--	--	0/3	3-OK 84	0/3	3-OK 84	--	--

NOTE: Test specimens: 0.125-in. dia. tensile specimens unless noted otherwise.
Test Environment: 84 days to 3.5% NaCl-AI per Federal Method 823.

• Retest using 0.225-m diam tensile specimen.
‡ Flat cover die, tensile specimen cannot be positioned across parting plane.
# 3/4-in. O.D. by 0.063-in. wall C-ring.
† F/N denotes number of specimens failed over number exposed.

TABLE LXXII

COMPARISON OF PER CENT SURVIVAL VERSUS EXPOSURE TIME FOR SHORT-TRANSVERSE SPECIMENS FROM 7049-T73 AND 7175-T736 DIE FORGINGS*

(F33615-71-C-1571)

45 ksi Stress Level						35 ksi Stress Level					
Days of Exposure	No. of Failures	Cumulative Failures	Cumulative Fraction	Cumulative % Failed	Cumulative % Survived	Days of Exposure	No. of Failures	Cumulative Failures	Cumulative Fraction	Cumulative % Failed	Cumulative % Survived
PART A. Preparation of Data for Plotting - See Fig. 96											
					7049-T73						
17	1	1	1/42	2	98	30	1	1	1/42	2	98
18	1	2	3/42	7	93	37	1	2	3/42	7	93
21	1	3	5/42	12	88	41	1	3	5/42	12	88
25	1	4	7/42	17	83	49	1	4	7/42	17	83
31	2	6	10/42	24	76	53	2	6	10/42	24	76
32	2	8	14/42	33	67	57	2	8	14/42	33	67
34	1	9	17/42	40	60	58	1	9	17/42	40	60
38	2	11	20/42	48	52	62	1	10	19/42	45	55
39	1	12	23/42	55	45	64	1	11	21/42	50	50
44	2	14	26/42	62	38	73	1	12	23/42	55	45
47	1	15	29/42	69	31	80	1	13	25/42	60	40
51	1	16	31/42	74	26	OK84	8	---	--	--	--
60	1	17	33/42	79	21						
OK84	4	--	--	--	--						
					7175-T736						
28	1	1	1/36	3	97	42	2	2	2/36	6	94
31	1	2	3/36	8	92	43	1	3	5/36	14	86
37	2	4	6/36	17	83	44	1	4	7/36	19	81
39	1	5	9/36	25	75	56	2	6	10/36	27	73
42	1	6	11/36	31	69	57	3	9	15/36	42	58
45	2	8	14/36	39	61	58	1	10	19/36	53	47
46	2	10	18/36	50	50	60	1	11	21/36	58	42
49	1	11	21/36	58	42	65	1	12	23/36	64	36
50	1	12	23/36	64	36	73	1	13	25/36	69	31
51	1	13	25/36	69	31	75	1	14	27/36	75	25
53	1	14	27/36	75	25	84	1	15	29/36	81	19
55	2	16	30/36	83	17	OK84	3	--	--	--	--
63	1	17	33/36	92	8						
72	1	18	35/36	97	3						

PART B: Final Comparison of Data

Alloy	Stress, ksi	Expected Life Days‡	No. of Tests	Standard Deviation	Possible Error†	Range in Days Containing 90% Of the Failures	Possible Range In Days of Expected (Avg.) Life
7049-T73	45	39	21	18.0	17.0%	21 - 57	32 - 46
7175-T736	45	46	18	10.9	9.0%	35 - 57	41 - 51
7049-T73	35	70	21	30.9	15.8%	39 - 101	58 - 82
7175-T736	35	60	18	19.3	11.8%	40 - 80	52 - 68

NOTE: 0.125-in. diameter specimens taken perpendicular to or across the parting plane.

* 7049-T73 - S. Nos. 410693, 410694, 410695, 410698 and 410700
7175-T736 - S. Nos. 410699, 410706, 410983 and 410984

‡ Mean failure time, equals time for 50 per cent survival.

† At a 90 per cent confidence level.

TABLE LXXIII

STATUS OF ATMOSPHERIC SCC TESTS OF 7049-T73 AND 7175-T736 DIE FORGINGS

(F33615-71-C-1571)

Alloy and Temper	Sample Number	Sample Thickness, in.	Producer	SCC Data: Stressed 45 ksi F/N+	Stressed 45 ksi Days	Stressed 35 ksi F/N+	Stressed 35 ksi Days	Stressed 25 ksi F/N+	Stressed 25 ksi Days
PART A - Seacoast Atmosphere									
7049-T73	410693	≤1.000	A	0/3	3-OK388	0/3	3-OK388	--	--
	410698	1.001-2.000	A	3/3	63,63,90	2/3	63,310,312 1-OK	--	--
7175-T736	410983	≤1.000	A	0/2	2-OK265	0/3	3-OK265	0/3	3-OK265
	410699	1.001-2.000	A	0/3	3-OK312	0/3	3-OK312	0/3	3-OK312
PART B - Industrial Atmosphere									
7049-T73	410693	≤1.000	A	0/3	3-OK446	0/3	3-OK446	--	--
	410698	1.001-2.000	A	1/3	F348,2-OK348	0/3	3-OK348	--	--
7175-T736	410983	≤1.000	A	0/3	3-OK315	0/3	3-OK315	0/3	3-OK315
	410699	1.001-2.000	A	0/3	3-OK348	0/3	3-OK348	0/3	3-OK348

NOTE: Short-transverse (0.125-in. dia.) tensile specimens taken 3/8-in. from base of flash.

+ F/N denotes number of specimens failed over number exposed.

TABLE LXXIV

RESULTS OF ACCELERATED SCC TESTS ON 7049-T73 HAND FORGINGS

(F33615-71-C-1571)

Sample Number	Sample Dimensions, in.	Producer	Original Tensile Properties: Ultimate Strength, ksi	Original Tensile Properties: Yield Strength, ksi	Elong, %	% Loss In Tensile Strength: Unstressed	% Loss In Tensile Strength: 75% Y.S.	SCC Data Stressed 75% Yield Strength: F/N†	SCC Data Stressed 75% Yield Strength: Days
PART A - Longitudinal Tests									
411019	2x16	A	74.3	65.6	14.0	14	24	0/3	OK84
410688	5x20	A	72.7	61.5	14.0	16	19	0/3	OK84
PART B - Long-Transverse Tests									
411019	2x16	A	73.5	65.0	8.0	23	37	0/3	OK84
410688	5x20	A	69.4	58.3	8.0	26	36	0/3	OK84

Sample Number	Sample Dimensions, in.	Producer	Conductivity % IACS	Original Tensile Properties: Ultimate Strength, ksi	Original Tensile Properties: Yield Strength, ksi	Elong, %	% Loss in Tensile Strength: Unstressed	% Loss in Tensile Strength: 45 ksi	% Loss in Tensile Strength: 35 ksi	SCC Data 45 ksi: F/N†	SCC Data 45 ksi: Days	SCC Data 35 ksi: F/N†	SCC Data 35 ksi: Days
PART C - Short-Transverse Tests*													
411019	2x16	A	40.4	73.9	67.1	6.0	32	--	57	3/3	38,47,48	2/3	64,82,1-OK84
410686	3x16	A	40.8	73.2	64.8	10.0	26	--	45	3/3	59,63,72	0/3	OK84
410966	4x16	A	41.3	70.1	58.7	9.0	24	54	41	0/3	OK84	0/3	OK84
410688	5x20	A	41.5	68.5	56.7	8.0	27	--	37	3/3	66,78,80	0/3	OK84

NOTE: 0.125-in. diameter tensile specimens exposed 84 days to 3.5% NaCl-AI per Federal Method 823.

* Short-transverse specimens also exposed to seacoast and industrial atmospheres.
† F/N denotes number of specimens failed over number exposed.

TABLE LXXV

RESULTS OF ACCELERATED SCC TESTS ON 7175-T736 HAND FORGINGS

(F33615-71-C-1571)

Sample Number	Sample Dimensions, in.	Producer	Original Tensile Properties: Ultimate Strength, ksi	Yield Strength, ksi	Elong, %	% Loss In Tensile Strength: Unstressed	75% Y.S.	SCC Data Stressed 75% Yield Strength: F/N†	Days
PART A - Longitudinal Tests									
410689	2x16	A	76.0	67.3	14.0	10	18	0/3	OK84
410986	5x20	A	70.1	59.9	16.0	12	17	0/3	OK84
PART B - Long-Transverse Tests									
410689	2x16	A	74.6	65.7	14.0	11	46	0/3	OK84
410986	5x20	A	75.1	66.5	15.0	19	28	0/3	OK84

Sample Number	Sample Dimensions, in.	Producer	Conductivity % IACS	Original Tensile Properties: Ultimate Strength, ksi	Yield Strength, ksi	Elong, %	% Loss in Tensile Strength: Unstressed	45 ksi	35 ksi	25 ksi	SCC Data 45 ksi: F/N†	Days	35 ksi: F/N†	Days	25 ksi: F/N†	Days
PART C - Short-Transverse Tests*																
410689	2x16	A	41.0	75.0	66.0	8.0	14	56	--	36	1/3	60,2-OK84	3/3	47,55,70	0/3	OK84
410985	3x12	A	41.1	75.0	65.5	7.0	22	--	--	31	3/3	50,50,57	3/3	63,71,78	0/3	OK84
410691	4x16	A	41.4	69.9	59.1	8.0	24	54	50	35	1/3	80,2-OK84	0/3	OK84	0/3	OK84
410986	5x20	A	41.5	72.3	64.2	8.0	23	51	--	30	0/3	OK84	3/3	60,64,82	0/3	OK84

NOTE: 0.125-in. diameter tensile specimens exposed 84 days to 3.5% NaCl-A.I. per Federal Method 823.

* Short-transverse specimens also exposed to seacoast and industrial atmospheres.
† F/N denotes number of specimens failed over number of specimens exposed.

TABLE LXXVI

RESULTS OF ACCELERATED SCC TESTS OF 7475 SHEET
(F33615-71-C-1571)

Sample		Producer	Original Tensile Properties			% Loss In Tensile Strength		SCC Data			
								Stressed 75% Yield Strength		Preforms	
Number	Thickness,* in.		Ultimate Strength, ksi	Yield Strength, ksi	Elong, %	Unstressed	75% Y.S.	F/N†	Days	F/N†	Days
PART A - T61 Temper											
410651	0.040	A	81.3	72.9	11.0	37	38	0/2	2-OK84	0/2	2-OK182
410653	0.063	A	80.8	72.6	12.0	24	25	0/2	2-OK84	0/2	2-OK182
410655	0.090	A	80.4	72.1	11.5	23	18	0/2	2-OK84	0/2	2-OK182
410657	0.125	A	80.4	72.6	13.0	24	20	0/2	2-OK84	0/2	2-OK182
410659	0.188	A	79.4	72.3	13.0	22	21	0/2	2-OK84	0/2	2-OK182
410661	0.249	A	80.8	73.4	13.0	23	24	0/2	2-OK84	0/2	2-OK182
PART B - T761 Temper											
410663	0.040	A	78.3	70.8	10.5	36	32	0/2	2-OK84	0/2	2-OK182
410665	0.063	A	76.9	69.0	10.5	13	23	0/2	2-OK84	0/2	2-OK182
410667	0.090	A	74.1	64.6	11.5	13	28	0/2	2-OK84	0/2	2-OK182
410669	0.125	A	75.3	64.9	12.0	14	21	0/2	2-OK84	0/2	2-OK182
410671	0.188	A	73.9	65.3	13.0	14	27	0/2	2-OK84	0/2	2-OK182
410673	0.249	A	74.9	65.9	14.0	14	30	0/2	2-OK84	0/2	2-OK182

NOTE: Test specimens: Long transverse sheet, tensile and preforms
Test Environment: 3.5% NaCl-AI per Federal Method 823
Exposure Periods: Tensiles - 84 days, Preforms - 182 days

* 0.040 and 0.063-in. gage tested full thickness, other gauges machined on one side to 0.063-in. and rolled surface stressed in tension.

† F/N denotes number of specimens failed over number of specimens exposed.

TABLE LXXVII

RESULTS OF SCC TESTS OF 2124-T851 PLATE

(F33615-71-C-1571)

Sample Number	Sample Thickness, in.	Producer	Original Tensile Properties: Ultimate Strength, ksi	Yield Strength, ksi	Elong, %	84 Days to 3.5% NaCl by Alternate Immersion per Federal Method 823: % Loss in Tensile Strength: Unstressed	75% Y.S.	58% GYS	50% GYS	Stressed 75% Y.S.‡: F/N†	Days	Stressed 58% GYS‡‡: F/N†	Days	Stressed 50% GYS‡‡: F/N†	Days	Seacoast Atmosphere*: Stressed 75% Y.S.‡: F/N†	Days
PART A - Longitudinal Tests																	
410675	1.75	A	72.0	67.0	10.0	18	13	--	--	0/3	3-OK 84	--	--	--	--	--	--
410680	2.00	C	71.5	66.2	9.5	16	17	--	--	0/3	3-OK 84	--	--	--	--	--	--
410678	4.50	A	70.2	63.4	8.0	18	19	--	--	0/3	3-OK 84	--	--	--	--	--	--
410683	4.50	C	67.8	59.8	8.0	19	27	--	--	0/3	3-OK 84	--	--	--	--	--	--
PART B - Long-Transverse Tests																	
410675	1.75	A	71.5	65.7	8.0	16	15	--	--	0/3	3-OK 84	--	--	--	--	--	--
410680	2.00	C	71.1	65.4	8.0	21	22	--	--	0/3	3-OK 84	--	--	--	--	--	--
410678	4.50	A	69.4	61.4	6.0	20	34	--	--	0/3	3-OK 84	--	--	--	--	--	--
410683	4.50	C	67.5	58.5	8.0	27	40	--	--	0/3	3-OK 84	--	--	--	--	--	--
PART C - Short-Transverse Tests																	
410675	1.75	A	70.4	65.3	3.1	33	--	27	--	3/3	4,4,5	2/3	62,84,OK84	3/3	7,84,84	3/3	78,78,78
410675**							--	--	33	3/3	5,8,18	--	--	1/3	53,2-OK84	--	--
410680	2.00	C	68.2	64.9	3.1	34	--	--	--	3/3	5,5,5	3/3	24,26,32	3/3	27,46,84	2/3	78,78,OK385
410680**							--	--	40	3/3	7,7,9	--	--	1/3	74,2-OK84	--	--
410681	2.04	B	68.2	62.7	4.7	45	--	--	--	3/3	4,6,12	3/3	41,42,63	3/3	39,45,84	2/3	78,182,OK385
410676	2.50	A	69.2	63.5	3.0	40	--	46	51	3/3	17,27,32	2/3#	65,84,OK84	1/3#	60,2-OK84	0/3	3-OK385
410678	4.50	A	65.6	59.8	3.0	32	34	38	41	2/3#	60,77,OK84	0/3	3-OK84	0/3	3-OK84	0/3	3-OK385
410683	4.50	C	64.1	57.3	2.5	44	--	62	51	3/3	33,64,65	2/3	57,64,OK84	0/3	3-OK84	0/3	3-OK385

NOTE: 0.125-in. diameter specimen except where noted.

* These items are also being tested at 58 and 50% GYS and in industrial atmosphere.
‡ 75% of actual yield strength.
‡‡ 58 and 50% of the guaranteed long transverse yield strength.
\# Metallographic examination detected only transgranular auxiliary cracks in these specimens.
† F/N denotes number of specimens failed over number of specimens exposed.
** Retests using 0.225-in. diameter specimens.

TABLE LXXVIII

RESULTS OF SCC TESTS WITH PRECRACKED SPECIMENS

(F33615-71-C-1571)

Product	Alloy and Temper	Sample		Producer	Location in Die Forging (See Fig. 34)	Crack Length - Inches*			Metallographic Nature of Cracking At Crack Tip
		Number	Thickness or Dimensions, in.			Edge of Specimen		Center of Spec.	
						Environmental‡	Total‡‡	Total‡‡	
Die Forging	7049-T73	410693	<1.000	A	Flange	0.02	0.07	0.30	Intergranular
		410693	<1.000	A	Web	0.05	0.10	0.34	Intergranular
	7175-T736	410983	<1.000	A	Flange	0.10	0.17	0.37	Intergranular
		410983	<1.000	A	Web	0.09	0.15	0.37	Intergranular
Hand Forging	7049-T73	411019	2x16	A		0.02	0.08	0.32	Intergranular
		410688	5x20	A		0.05	0.10	0.31	Intergranular
	7175-T736	410689	2x16	A		0.03	0.08	0.29	Intergranular
		410986	5x20	A		0.02	0.06	0.30	Intergranular
Plate	2124-T851	410675	1.75	A		0.26	0.37	0.53	Intergranular
		410676	2.50	A		0.07	0.15	0.33	Transgranular
		410677	3.50	A		0.08	0.13	0.32	Transgranular
		410678	4.50	A		0.05	0.11	0.26	Transgranular
		410679	5.50	A		0.01	0.08	0.25	Transgranular

NOTE: Test Specimen: Short-transverse (S-L) double cantilever beam precracked in tension and bolt loaded to pop-in.
Test Environment: Air at 80 F, 45% R.H. plus 3.5% NaCl dropwise three times per day for 30 days.

* Average of duplicate specimens.
‡ Length of the crack that developed in the corrosive environment.
‡‡ Includes both the mechanical precrack and the environmental crack.

APPENDIX

TABLE LXXIX

FATIGUE CRACK GROWTH DATA FOR 7049-T73 HAND FORGINGS
Constant Load Tests, Stress Ratio = + 1/3

(F33615-71-C-1571)

4X16IN T-L CT SPEC DRY AIR,RT 18.3HZ

A10966_TL1_7049-T73 — MAX LOAD = 3.91 KIPS, T = 1.4980 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.250	1.430	35.2
18700.	1.330	1.510	37.3
31400.	1.380	1.580	38.9
39600.	1.430	1.630	40.2
47000.	1.480	1.680	41.5
54800.	1.530	1.730	42.8
60500.	1.580	1.790	44.3
68100.	1.650	1.850	46.0
72700.	1.700	1.900	47.3
76800.	1.750	1.950	48.6
80600.	1.800	2.000	49.9
83500.	1.850	2.050	51.2
86200.	1.900	2.100	52.6
88700.	1.950	2.150	53.9
90200.	2.000	2.180	54.9
92200.	2.050	2.240	56.4
93500.	2.100	2.290	57.7
94300.	2.150	2.350	59.1
94900.	2.230	2.400	60.8
94900.	2.250	2.410	61.2
94900.	3.810	3.810	100.1

5X20IN T-L CT SPEC DRY AIR,RT 18.3HZ

A10688TL8_7049T73 — MAX LOAD = 3.89 KIPS, T = 1.5020 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.280	1.290	33.8
6700.	1.340	1.340	35.2
34500.	1.450	1.450	[illegible]
50800.	1.500	1.500	39.4
62500.	1.550	1.550	40.7
69800.	1.590	1.610	42.0
82500.	1.670	1.690	44.2
87400.	1.710	1.730	45.2
94400.	1.790	1.780	46.9
104000.	1.830	1.830	48.1
111600.	1.880	1.890	49.5
115500.	1.970	1.920	51.1
118600.	2.000	1.950	51.9
121700.	2.050	2.010	53.4
124100.	2.110	2.080	55.1
126400.	2.160	2.140	56.5
127900.	2.200	2.200	57.8
128400.	2.250	2.250	59.1
128800.	2.300	2.370	61.4
129200.	2.300	2.440	62.3
129200.	3.810	3.810	100.1

5X20IN T-L CT SPEC HUMID AIR,RT 18.3HZ

A10688TL9_7049T73 — MAX LOAD = 3.90 KIPS, T = 1.5010 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.310	1.370	35.2
6500.	1.360	1.420	36.5
14900.	1.430	1.460	38.0
20400.	1.480	1.500	39.2
33400.	1.480	1.600	40.5
36600.	1.640	1.600	42.6
37600.	1.700	1.650	44.0
38600.	1.750	1.700	45.3
39700.	1.760	1.810	46.9
45400.	1.850	1.820	48.2
47300.	1.920	1.870	49.8
49100.	1.970	1.960	51.6
49800.	2.000	2.020	52.8
50500.	2.020	2.100	54.1
51200.	2.070	2.150	55.5
52000.	2.140	2.200	57.0
52900.	2.250	2.250	59.1
53300.	2.250	2.370	60.7
53300.	3.810	3.810	100.1

5X20IN T-L CN SPEC SALT FOG,RT 5.2HZ

A10688ML5_7049T73 — MAX LOAD = 18.63 KIPS, T = .7518 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.64
23200.	.215	.225	.640	21.30
34200.	.280	.290	.770	25.62
41900.	.340	.360	.900	29.95
51700.	.455	.480	1.135	37.77
55100.	.540	.550	1.290	42.93
58700.	.650	.650	1.500	49.92
60200.	.710	.725	1.635	54.41
62000.	.765	.775	1.740	57.90
64000.	.845	.880	1.925	64.06
64200.	.910	.950	2.060	68.55

A10688ML6_7049T73 — MAX LOAD = 30.34 KIPS, T = .7505 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	16.64
3700.	.205	.195	.600	19.97
5900.	.255	.245	.700	23.29
7600.	.305	.295	.800	26.62
9200.	.380	.355	.935	31.11
10000.	.450	.400	1.050	34.94
10400.	.520	.445	1.165	38.77
10500.	.560	.445	1.205	40.10

A10688ML7_7049T73 — MAX LOAD = 18.53 KIPS, T = .7492 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.145	.155	.500	16.64
20600.	.210	.215	.625	20.80
25700.	.250	.250	.700	23.29
32300.	.300	.305	.805	26.79
39500.	.375	.375	.950	31.61
43200.	.430	.430	1.060	35.27
46000.	.475	.475	1.150	38.27
48100.	.520	.515	1.235	41.10
49700.	.560	.560	1.320	43.93
51500.	.615	.615	1.430	47.59
53200.	.695	.695	1.590	52.91
54600.	.765	.765	1.730	57.57
56000.	.840	.840	1.880	62.56
57100.	.965	.940	2.105	70.05
57300.	1.000	.950	2.150	71.55

5X20IN L-T CN SPEC DRY AIR,RT 5.2HZ

A10688_L1_7049T73 — MAX LOAD = 18.44 KIPS, T = .7479 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.160	.140	.500	16.67
36200.	.200	.185	.585	19.50
69100.	.255	.230	.685	22.83
88500.	.310	.290	.800	26.67
110700.	.375	.340	.915	30.50
121300.	.425	.385	1.010	33.67
130700.	.480	.435	1.115	37.17
137300.	.530	.485	1.215	40.50
141000.	.570	.550	1.320	44.00
147000.	.625	.585	1.410	47.00
152300.	.690	.650	1.540	51.33
155900.	.750	.710	1.660	55.33
159100.	.810	.775	1.785	59.50
162000.	.885	.835	1.920	64.00
163700.	.940	.890	2.030	67.67
165200.	1.000	.945	2.145	71.50
166400.	1.070	1.010	2.280	76.00
167000.	1.130	1.055	2.385	79.50
167400.	1.200	1.095	2.495	83.17

5X20IN S-T CT SPEC DRY AIR,RT 18.3HZ

A10688ST1_7049T73 — MAX LOAD = 3.90 KIPS, T = 1.5000 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.200	1.460	35.0
51300.	1.250	1.540	36.7
69800.	1.300	1.580	37.8
95000.	1.380	1.600	39.2
124800.	1.480	1.600	40.5
132900.	1.500	1.680	41.8
160300.	1.550	1.740	43.2
171700.	1.670	1.900	46.9
181000.	1.720	1.960	48.4
187300.	1.830	1.970	49.9
190900.	1.870	2.000	50.9
193900.	1.940	2.120	53.4
198300.	2.040	2.180	55.5
201100.	2.070	2.240	56.6
205000.	2.120	2.320	58.3
206900.	2.300	2.350	61.1
207500.	2.360	2.440	63.1
207500.	3.810	3.810	100.1

4X16IN T-L CT SPEC HUMID AIR,RT 18.3HZ

A10966TL2_7049T73 — MAX LOAD = 3.91 KIPS, T = 1.4980 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.310	1.330	34.7
7600.	1.400	1.400	36.8
12000.	1.450	1.450	38.1
20700.	1.530	1.510	39.9
22500.	1.560	1.540	40.7
25900.	1.610	1.580	41.9
30700.	1.660	1.630	43.2
34200.	1.710	1.670	44.4
38100.	1.780	1.700	45.7
41800.	1.850	1.720	46.9
45000.	1.880	1.780	48.1
47800.	1.920	1.850	49.5
50200.	2.010	1.900	51.4
52300.	2.070	2.020	53.7
54300.	2.100	2.080	54.9
55300.	2.200	2.100	56.5
56000.	2.280	2.180	58.6
56100.	2.320	2.220	59.7
56100.	3.810	3.810	100.1

5X20IN T-L CN SPEC DRY AIR,RT 5.2 HZ

A10688ML1_7049T73 — MAX LOAD = 18.48 KIPS, T = .7471 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.120	.140	.460	15.31
14100.	.140	.160	.500	16.64
38200.	.180	.200	.580	19.30
61100.	.240	.255	.695	23.13
81700.	.300	.310	.810	26.96
92200.	.350	.360	.910	30.28
102200.	.400	.415	1.015	33.78
110500.	.455	.460	1.115	37.10
116200.	.510	.510	1.220	40.60
121900.	.560	.560	1.320	43.93
124400.	.610	.615	1.425	47.42
128500.	.660	.665	1.525	50.75
132200.	.745	.745	1.690	56.24
134300.	.815	.815	1.830	60.90
135400.	.875	.875	1.950	64.89
136600.	1.010	.965	2.175	72.38
136700.	1.040	.975	2.215	73.71

A10688ML2_7049T73 — MAX LOAD = 30.33 KIPS, T = .7516 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.63
3300.	.195	.205	.600	19.96
5800.	.240	.250	.690	22.95
7500.	.305	.315	.820	27.28
8200.	.360	.375	.935	31.10
8500.	.395	.400	.995	33.10

5X20IN T-L CN SPEC HUMID AIR,RT 5.2HZ

A10688ML3_7049T73 — MAX LOAD = 18.49 KIPS, T = .7498 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	16.64
13700.	.195	.185	.580	19.30
52300.	.315	.305	.820	27.29
60000.	.355	.345	.900	29.95
69200.	.430	.420	1.050	34.94
74400.	.480	.470	1.150	38.27
78500.	.535	.520	1.255	41.76
81600.	.585	.570	1.355	45.09
84700.	.660	.625	1.485	49.42
85900.	.715	.675	1.590	52.91
88500.	.790	.730	1.720	57.24
89600.	.915	.800	1.915	63.73
89700.	.920	.810	1.930	64.23

A10688ML4_7049T73 — MAX LOAD = 30.40 KIPS, T = .7520 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	16.64
3500.	.195	.190	.585	19.47
6000.	.250	.230	.680	22.63
8700.	.300	.295	.795	26.46
10600.	.370	.350	.920	30.62
11300.	.445	.410	1.055	35.11
12000.	.520	.450	1.170	38.94
12200.	.565	.475	1.240	41.26

5X20IN L-T CN SPEC HUMID AIR,RT 5.2HZ

A10688_L2_7049T73 — MAX LOAD = 18.51 KIPS, T = .7500 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.140	.160	.500	16.67
25100.	.190	.210	.600	20.00
43600.	.235	.270	.705	23.50
58500.	.295	.330	.825	27.50
70800.	.375	.390	.965	32.17
76800.	.425	.460	1.085	36.17
82400.	.475	.515	1.190	39.67
86700.	.525	.565	1.290	43.00
89900.	.575	.610	1.385	46.17
93900.	.620	.670	1.490	49.67
98100.	.680	.725	1.605	53.50
101100.	.740	.790	1.730	57.67
103100.	.785	.855	1.840	61.33
104700.	.840	.935	1.975	65.83
106200.	.895	1.010	2.105	70.17
107200.	.945	1.120	2.265	75.50
107500.	.980	1.185	2.365	78.83

5X20IN S-T CT SPEC HUMID AIR,RT 18.3HZ

A10688_ST2_7049-T73 — MAX LOAD = 3.87 KIPS, T = 1.5010 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.520	1.250	36.4
443900.	1.580	1.250	37.2
770200.	1.630	1.270	38.1
902400.	1.670	1.330	39.4
1057301.	1.720	1.380	40.7
1235900.	1.770	1.420	41.9
1410099.	1.880	1.730	47.4
1445199.	1.910	1.800	48.8
1488400.	1.960	1.920	51.0
1504400.	2.010	1.980	52.4
1529200.	2.050	2.050	53.9
1534699.	2.100	2.080	54.9
1542599.	2.170	2.140	56.6
1550699.	2.280	2.250	59.5
1556600.	2.370	2.380	62.4
1558499.	2.450	2.420	64.0
1559399.	2.500	2.560	66.5
1559399.	3.810	3.810	100.1

4X16IN T-L CT SPEC SALT FOG,RT 18.3HZ

A10966_TL3_7049-T73 — MAX LOAD = 3.90 KIPS, T = 1.4950 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.340	1.280	34.4
8800.	1.400	1.320	35.7
13400.	1.450	1.380	37.2
18100.	1.510	1.420	38.5
28600.	1.560	1.500	40.2
33600.	1.610	1.550	41.5
39200.	1.660	1.600	42.8
43900.	1.750	1.640	44.5
47200.	1.790	1.700	45.9
50100.	1.830	1.750	47.0
54700.	1.900	1.800	48.6
58200.	1.950	1.850	49.9
60400.	2.000	1.900	51.2
62200.	2.050	1.950	52.6
64100.	2.100	2.000	53.9
66300.	2.150	2.050	55.2
67400.	2.200	2.100	56.5
68700.	2.250	2.150	57.8
69700.	2.350	2.250	60.4
69900.	2.380	2.280	61.2
69900.	3.810	3.810	100.1

5X20IN L-T CN SPEC SALT FOG,RT 5.2HZ

A10688_L3_7049T73 — MAX LOAD = 18.39 KIPS, T = .7492 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	16.69
5700.	.170	.150	.520	17.36
17800.	.185	.180	.565	18.86
28300.	.230	.225	.655	21.87
34500.	.250	.270	.720	24.04
42100.	.290	.300	.790	26.38
45800.	.325	.325	.850	28.38
53400.	.420	.410	1.030	34.39
56900.	.470	.465	1.135	37.90
61400.	.525	.525	1.250	41.74
67200.	.610	.620	1.430	47.75
70400.	.685	.690	1.575	52.59
71900.	.720	.740	1.660	55.43
74100.	.775	.795	1.770	59.10
76500.	.860	.875	1.935	64.61
77900.	.960	.945	2.105	70.28
79700.	1.080	1.120	2.400	80.13
79900.	1.135	1.200	2.535	84.64
80000.	1.140	1.205	2.545	84.97
80000.	1.400	1.400	3.000	100.17

NOTES: CN = Center Notch Specimen, Fig. 23.
Crack lengths are average readings on front and back surface; total notch length includes machined flaw of 0.20 in.

CT = Compact Tension Crack Growth Specimen, Fig. 24.
Crack lengths are measured from load line.

T = Specimen thickness.

TABLE LXXX

FATIGUE CRACK GROWTH DATA FOR 7175-T736 HAND FORGINGS

Constant Load Tests, Stress Ratio = + 1/3

(F33615-71-C-1571)

4X16IN T-L CT SPEC DRY AIR,RT 18.3HZ

T = 1.5020
410621_TL1_7175-T736_ _MAX_LOAD = 3.89_KI

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.300	1.290	34.0
11900.	1.330	1.360	35.3
25200.	1.380	1.410	36.7
36500.	1.410	1.460	37.7
51800.	1.450	1.520	39.0
64100.	1.500	1.580	40.5
75300.	1.550	1.630	41.8
83700.	1.600	1.680	43.1
90500.	1.650	1.740	44.5
99300.	1.700	1.800	46.0
104800.	1.760	1.840	47.3
109600.	1.800	1.870	48.2
114500.	1.850	1.910	49.4
119600.	1.900	1.970	50.9
124100.	1.960	2.020	52.3
127600.	2.010	2.060	53.5
130900.	2.060	2.100	54.7
134100.	2.130	2.150	56.2
137500.	2.190	2.210	57.8
138900.	2.250	2.250	59.1
140800.	2.310	2.300	60.6
141600.	2.350	2.330	61.5
142700.	2.410	2.380	62.9
143600.	2.480	2.450	64.8
143800.	2.520	2.480	65.7
143800.	3.810	3.810	100.1

5X20IN T-L CT SPEC DRY AIR,RT 18.3HZ

T = 1.5020 IN.
410986-TL7_7175-T736_ _MAX_LOAD = 3.88_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.300	1.260	33.6
22400.	1.350	1.300	34.8
44700.	1.400	1.350	36.1
65800.	1.450	1.400	37.5
82300.	1.500	1.450	38.8
93300.	1.540	1.500	39.9
111800.	1.600	1.570	41.7
126100.	1.650	1.640	43.2
138200.	1.700	1.700	44.7
147800.	1.760	1.750	46.1
156700.	1.810	1.800	47.4
165800.	1.860	1.850	48.8
170100.	1.900	1.900	49.9
177500.	1.950	1.950	51.2
182700.	2.000	2.000	52.6
190900.	2.050	2.050	53.9
194800.	2.100	2.100	55.2
200000.	2.150	2.150	56.5
205100.	2.210	2.210	58.1
206800.	2.250	2.250	59.1
209700.	2.310	2.320	60.8
211800.	2.360	2.360	62.0
213100.	2.430	2.430	63.9
214100.	2.490	2.480	65.3
214500.	2.550	2.520	66.6
215100.	2.680	2.600	69.4
215500.	2.710	2.620	70.0
215500.	3.810	3.810	100.1

5X20IN T-L CT SPEC HUMID AIR,RT 18.3HZ

T = 1.5010 IN.
410986-TL8_7175-T736_ _MAX_LOAD = 3.88_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.340	1.340	35.2
9600.	1.390	1.420	36.9
18600.	1.460	1.490	38.8
27100.	1.510	1.550	40.2
33300.	1.580	1.610	41.9
40000.	1.640	1.680	43.6
44600.	1.680	1.730	44.8
48900.	1.730	1.780	46.1
52500.	1.780	1.830	47.4
56600.	1.840	1.890	49.0
61000.	1.900	1.960	50.7
63800.	1.960	2.010	52.2
66200.	2.010	2.060	53.5
68800.	2.060	2.120	54.9
70300.	2.100	2.160	56.0
72400.	2.160	2.230	57.7
74000.	2.210	2.280	59.0
75600.	2.280	2.360	61.0
76900.	2.340	2.430	62.7
77700.	2.410	2.540	65.0
78000.	2.470	2.630	67.0
78000.	3.810	3.810	100.1

5X20IN T-L CT SPEC SALT FOG,RT 18.3HZ

T = 1.5010 IN.
410986-TL9_7175-T736_ _MAX_LOAD = 3.90_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.290	1.290	33.9
18400.	1.350	1.340	35.3
25200.	1.430	1.380	36.9
34400.	1.480	1.430	38.2
40600.	1.500	1.510	39.6
47900.	1.560	1.550	40.9
55000.	1.610	1.590	42.0
58800.	1.670	1.650	43.6
65500.	1.730	1.700	45.1
69900.	1.780	1.750	46.4
74600.	1.850	1.820	48.2
79000.	1.900	1.870	49.5
82600.	1.950	1.940	51.1
86600.	2.010	1.990	52.6
88900.	2.050	2.050	53.9
91700.	2.110	2.100	55.3
94400.	2.180	2.150	56.9
95800.	2.220	2.200	58.1
97100.	2.260	2.250	59.3
98700.	2.320	2.300	60.7
100500.	2.400	2.370	62.7
102000.	2.460	2.470	65.0
102800.	2.600	2.650	69.0
102800.	3.810	3.810	100.1

5X20IN L-T CN SPEC DRY AIR,RT 5.2HZ

T = .7474 IN.
410986LW1 _7175T736 _ _MAX_LOAD =18.49_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.68
54100.	.225	.225	.650	21.69
78300.	.275	.285	.760	25.36
99000.	.345	.345	.890	29.70
110400.	.400	.395	.995	33.20
117300.	.480	.480	1.160	38.71
124400.	.520	.530	1.250	41.71
129700.	.570	.580	1.350	45.05
134400.	.655	.665	1.520	50.72
137200.	.695	.710	1.605	53.55
141800.	.775	.795	1.770	59.06
143400.	.845	.865	1.910	63.73
144900.	.900	.930	2.030	67.73
146200.	.930	.970	2.100	70.07
147400.	.980	1.030	2.210	73.74
148300.	1.030	1.100	2.330	77.74
149200.	1.070	1.230	2.500	83.42

5X20IN S-T CT SPEC DRY AIR,RT 18.3HZ

T = 1.5000 IN.
410986_SI1_7175-T736_ _MAX_LOAD = 3.85_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.550	1.240	37.2
54800.	1.580	1.350	38.5
85900.	1.630	1.410	39.9
110400.	1.660	1.470	41.1
135300.	1.700	1.540	42.6
152800.	1.750	1.590	43.9
180300.	1.820	1.700	46.3
189000.	1.850	1.760	47.4
201500.	1.920	1.840	49.4
211500.	1.980	1.900	51.0
216700.	2.030	1.960	52.4
223500.	2.080	2.020	53.9
227800.	2.130	2.070	55.2
231900.	2.170	2.140	56.6
235100.	2.220	2.190	58.0
237400.	2.270	2.250	59.4
238800.	2.310	2.300	60.6
240100.	2.360	2.360	62.0
240600.	2.420	2.420	63.6
240700.	2.440	2.440	64.1
240700.	3.810	3.810	100.1

4X16IN T-L CT SPEC HUMID AIR,RT 18.3HZ

T = 1.5010 IN.
410621_TL2_7175-T736_ _MAX_LOAD = 3.88_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.280	1.320	34.2
7900.	1.330	1.370	35.5
18300.	1.380	1.440	37.1
26600.	1.440	1.500	38.6
34100.	1.490	1.550	39.9
42900.	1.550	1.610	41.5
47900.	1.590	1.650	42.6
53600.	1.650	1.720	44.3
57900.	1.700	1.770	45.6
62700.	1.750	1.820	46.9
66300.	1.800	1.870	48.2
69700.	1.850	1.920	49.5
73200.	1.900	1.980	51.0
75700.	1.950	2.030	52.3
78900.	2.010	2.090	53.9
81500.	2.060	2.140	55.2
83500.	2.120	2.200	56.8
85500.	2.190	2.260	58.5
87100.	2.240	2.300	59.7
88300.	2.300	2.350	61.1
89500.	2.350	2.400	62.4
90300.	2.420	2.460	64.1
91000.	2.500	2.530	66.1
91000.	3.810	3.810	100.1

5X20IN T-L CN SPEC DRY AIR,RT 5.2 HZ

T = .7430 IN.
410986ML1 _7175T736 _ _MAX_LOAD =18.39_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.145	.155	.500	16.67
33900.	.200	.205	.605	20.17
54700.	.255	.255	.710	23.67
77500.	.315	.320	.835	27.84
88500.	.365	.365	.930	31.01
99900.	.425	.425	1.050	35.01
106600.	.475	.470	1.145	38.18
115200.	.540	.535	1.275	42.51
120100.	.600	.595	1.395	46.52
124200.	.670	.665	1.535	51.18
128900.	.765	.750	1.715	57.19
132400.	.865	.830	1.895	63.19
133300.	.925	.895	2.020	67.36
133800.	.945	.970	2.115	70.52
133900.	.995	.955	2.150	71.69

T = .7457 IN.
410986ML2 _7175T732 _ _MAX_LOAD =30.09_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.67
8900.	.215	.215	.630	21.00
14000.	.275	.275	.750	25.00
17600.	.335	.335	.870	29.00
19500.	.385	.385	.970	32.33
22000.	.445	.445	1.090	36.33
23600.	.510	.510	1.220	40.67
25000.	.570	.570	1.340	44.67
26200.	.655	.650	1.505	50.17
26800.	.735	.735	1.670	55.67
27000.	.770	.765	1.735	57.83

5X20IN T-L CN SPEC HUMID AIR,RT 5.2HZ

T = .7457 IN.
410986ML3 _7175T732 _ _MAX_LOAD =18.36_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.67
28600.	.210	.210	.620	20.67
44100.	.275	.255	.730	24.34
64000.	.340	.330	.870	29.01
72800.	.405	.390	.995	33.18
82700.	.470	.460	1.130	37.68
88700.	.535	.530	1.265	42.18
94400.	.595	.575	1.370	45.68
98300.	.655	.640	1.495	49.85
101700.	.725	.710	1.635	54.52
104000.	.795	.775	1.770	59.02
105500.	.865	.825	1.890	63.02
107000.	.970	.910	2.080	69.36
107500.	1.030	.935	2.165	72.19

T = .7440 IN.
410986ML4 _7175T732 _ _MAX_LOAD =30.03_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.69
8000.	.225	.215	.640	21.36
11600.	.265	.265	.730	24.37
14600.	.325	.325	.850	28.37
18000.	.415	.415	1.030	34.38
19100.	.460	.455	1.115	37.22
20000.	.505	.505	1.210	40.39
21200.	.550	.550	1.300	43.39
22200.	.605	.605	1.410	47.06
23100.	.740	.705	1.645	54.91
23300.	.805	.745	1.750	58.41

5X20IN T-L CN SPEC SALT FOG,RT 5.2HZ

T = .7508 IN.
410986ML5 _7175T736 _ _MAX_LOAD =18.51_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.67
11300.	.195	.185	.580	19.34
25400.	.235	.240	.675	22.51
32900.	.290	.305	.795	26.51
41200.	.350	.365	.915	30.51
46300.	.435	.455	1.090	36.35
51600.	.525	.540	1.265	42.18
55300.	.630	.650	1.480	49.35
56700.	.680	.700	1.580	52.68
58700.	.775	.795	1.770	59.02
59600.	.830	.850	1.880	62.69
60400.	.875	.895	1.970	65.69
61500.	.935	.975	2.110	70.36
61800.	1.020	1.040	2.260	75.36
62000.	1.030	1.080	2.310	77.03

T = .7478 IN.
410986ML6 _7175T736 _ _MAX_LOAD =30.12_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.145	.155	.500	16.69
5200.	.200	.205	.605	20.20
11200.	.280	.280	.760	25.38
13700.	.350	.355	.905	30.22
15600.	.410	.410	1.020	34.06
17100.	.465	.465	1.130	37.73
18100.	.530	.530	1.260	42.07
18900.	.595	.585	1.380	46.08
19600.	.675	.645	1.520	50.75
20000.	.720	.690	1.610	53.76
20500.	.800	.800	1.800	60.10

5X20IN L-T CN SPEC HUMID AIR,RT 5.2HZ

T = .7462 IN.
410986LW2 _7175T736 _ _MAX_LOAD =18.38_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.145	.155	.500	16.67
30000.	.200	.205	.605	20.17
49000.	.250	.260	.710	23.67
66400.	.305	.320	.825	27.51
76600.	.360	.375	.935	31.18
85100.	.425	.440	1.065	35.51
90900.	.480	.495	1.175	39.18
95200.	.525	.540	1.265	42.18
100100.	.590	.600	1.390	46.35
105500.	.670	.690	1.560	52.02
110100.	.815	.840	1.855	61.85
112400.	.875	.900	1.975	65.86
114100.	.955	.985	2.140	71.36
114800.	1.020	1.055	2.275	75.86
115600.	1.080	1.140	2.420	80.69
116000.	1.120	1.205	2.525	84.19

5X20IN S-T CT SPEC HUMID AIR,RT 18.3HZ

T = 1.5000 IN.
410986_SI2_7175-T736_ _MAX_LOAD = 3.88_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.440	1.360	36.8
43400.	1.500	1.410	38.2
76600.	1.540	1.460	39.4
116100.	1.590	1.530	41.0
144700.	1.640	1.600	42.6
171400.	1.700	1.680	44.4
188500.	1.750	1.750	46.0
203700.	1.820	1.820	47.8
215200.	1.890	1.890	49.7
221900.	1.940	1.940	51.0
228200.	2.000	2.000	52.6
232000.	2.050	2.050	53.9
235300.	2.100	2.100	55.2
238000.	2.160	2.160	56.8
240300.	2.220	2.230	58.5
241900.	2.280	2.280	59.9
243300.	2.340	2.340	61.5
244200.	2.390	2.390	62.8
244800.	2.470	2.490	65.2
244800.	3.810	3.810	100.1

4X16IN T-L CT SPEC SALT FOG,RT 18.3HZ

T = 1.5010 IN.
410621_TL3_7175-T736_ _MAX_LOAD = 3.90_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.380	1.270	34.8
10200.	1.430	1.320	36.1
18800.	1.500	1.360	37.6
27400.	1.550	1.410	38.9
32600.	1.600	1.450	40.1
41100.	1.650	1.500	41.4
44400.	1.700	1.550	42.7
51800.	1.750	1.600	44.0
57100.	1.800	1.650	45.3
61700.	1.850	1.770	47.6
65000.	1.900	1.800	48.6
68400.	1.950	1.850	49.9
71800.	2.000	1.900	51.2
74700.	2.050	1.950	52.6
76700.	2.100	2.000	53.9
78800.	2.140	2.050	55.1
81000.	2.200	2.100	56.5
82900.	2.240	2.160	57.8
85100.	2.300	2.250	59.8
87000.	2.350	2.330	61.5
88500.	2.450	2.400	63.7
89300.	2.540	2.510	66.4
89300.	3.810	3.810	100.1

5X20IN L-T CN SPEC SALT FOG,RT 5.2HZ

T = .7444 IN.
410986LW3 _7175T736 _ _MAX_LOAD =18.38_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.67
20800.	.210	.210	.620	20.67
30300.	.260	.260	.720	24.01
36800.	.325	.325	.850	28.34
42600.	.400	.395	.995	33.18
47000.	.470	.460	1.130	37.68
50700.	.550	.525	1.275	42.51
53600.	.655	.615	1.470	49.02
55200.	.735	.680	1.615	53.85
56200.	.785	.725	1.710	57.02
57400.	.865	.805	1.870	62.35
58300.	.945	.860	2.005	66.86
58900.	1.010	.900	2.110	70.36
59600.	1.070	.970	2.240	74.69
60200.	1.180	1.040	2.420	80.69

5X20IN S-T CT SPEC SALT FOG,RT 5.2HZ

T = 1.5010 IN.
410986_SI3_7175-T736_ _MAX_LOAD = 3.90_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PE CENT CRACKED
0.	1.280	1.520	36.8
29600.	1.380	1.520	38.1
75400.	1.450	1.550	39.4
97800.	1.520	1.580	40.7
134400.	1.560	1.650	42.2
155200.	1.600	1.700	43.4
176600.	1.650	1.750	44.7
208000.	1.710	1.800	46.1
218200.	1.770	1.800	46.9
231500.	1.800	1.840	47.8
243400.	1.840	1.890	49.0
258200.	1.890	1.930	50.2
268400.	1.950	1.980	51.6
277800.	2.030	2.050	53.6
282500.	2.080	2.100	54.9
287900.	2.150	2.150	56.5
290900.	2.200	2.220	58.1
294300.	2.300	2.300	60.4
295800.	2.350	2.350	61.8
296900.	2.400	2.400	63.1
298000.	2.450	2.450	64.4
299100.	2.600	2.600	68.3
299100.	3.810	3.810	100.1

NOTES: CN = Center Notch Specimen, Fig. 23.
Crack lengths are average readings on front and back surface; total notch length includes machined flaw of 0.20 in.

CT = Compact Tension Crack Growth Specimen, Fig. 24.
Crack lengths are measured from load line.

T = Specimen thickness.

TABLE LXXXI

FATIGUE CRACK GROWTH DATA FOR 7475-T61 SHEET
Constant Load Tests, Stress Ratio = + 1/3

(F33615-71-C-1571)

.040IN T-L CN SPEC DRY AIR,RT 13.3HZ

T = .0422 IN.
410652_T1 _7475 T61 _ _MAX_LOAD = 1.43_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.135	.165	.500	12.50
33900.	.180	.215	.595	14.87
64800.	.235	.275	.710	17.75
92400.	.305	.355	.860	21.50
112400.	.375	.425	1.000	25.00
125400.	.430	.485	1.115	27.87
137600.	.485	.540	1.225	30.62
148600.	.555	.610	1.365	34.12
159700.	.635	.680	1.515	37.87
166900.	.690	.750	1.640	41.00
173300.	.750	.810	1.760	44.00
179700.	.820	.890	1.910	47.75
184700.	.885	.955	2.040	51.00
189500.	.940	1.030	2.170	54.25
192500.	.990	1.105	2.295	57.38
196500.	1.060	1.155	2.415	60.37
199900.	1.135	1.235	2.570	64.25
203000.	1.200	1.310	2.710	67.75
205000.	1.250	1.370	2.820	70.50
206100.	1.310	1.455	2.965	74.13
207100.	1.380	1.570	3.150	78.75
207800.	1.490	1.900	3.590	89.75

.040IN T-L CN SPEC HUMID AIR,RT 13.3HZ

T = .0422 IN.
410652_T2 _7475 T61 _ _MAX_LOAD = 1.46_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
23100.	.240	.240	.680	17.00
30900.	.290	.290	.780	19.50
38700.	.345	.350	.895	22.37
45800.	.410	.410	1.020	25.50
51200.	.475	.470	1.145	28.62
54800.	.535	.530	1.265	31.62
58700.	.590	.585	1.375	34.38
62000.	.640	.635	1.475	36.87
66100.	.725	.725	1.650	41.25
69200.	.810	.810	1.820	45.50
71200.	.870	.870	1.940	48.50
73100.	.930	.935	2.065	51.63
74300.	.995	1.000	2.195	54.88
76000.	1.070	1.080	2.350	58.75
77400.	1.155	1.160	2.515	62.88
78600.	1.235	1.240	2.675	66.88
79400.	1.305	1.310	2.815	70.38
79800.	1.360	1.360	2.920	73.00
80400.	1.450	1.450	3.100	77.50
81500.	1.510	1.600	3.310	82.75
81500.	1.900	1.900	4.000	100.00

.040IN T-L CN SPEC SALT FOG,RT 13.3HZ

T = .0422 IN.
410652_T3 _7475 T61 _ _MAX_LOAD = 1.45_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
15900.	.240	.230	.670	16.75
22100.	.290	.280	.770	19.25
29900.	.370	.360	.930	23.25
34100.	.430	.420	1.050	26.25
37800.	.490	.485	1.175	29.38
41300.	.550	.550	1.300	32.50
43500.	.600	.600	1.400	35.00
46100.	.660	.660	1.520	38.00
48400.	.730	.730	1.660	41.50
50000.	.790	.790	1.780	44.50
52800.	.870	.870	1.940	48.50
54800.	.940	.940	2.080	52.00
56100.	1.000	1.000	2.200	55.00
57400.	1.065	1.080	2.345	58.63
58900.	1.175	1.180	2.555	63.88
60100.	1.290	1.300	2.790	69.75
61100.	1.400	1.415	3.015	75.38
61600.	1.575	1.630	3.405	85.13
61900.	1.685	1.900	3.785	94.63

.125IN T-L CN SPEC DRY AIR,RT 13.3HZ

T = .1260 IN.
410658_T1 _7475 T61 _ _MAX_LOAD = 4.32_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
40500.	.205	.205	.610	15.25
78000.	.295	.295	.790	19.75
94900.	.350	.350	.900	22.50
109100.	.410	.410	1.020	25.50
120100.	.460	.470	1.130	28.25
127300.	.505	.515	1.220	30.50
133800.	.560	.575	1.335	33.38
145100.	.635	.640	1.475	36.87
154400.	.750	.755	1.705	42.63
159400.	.825	.835	1.860	46.50
162500.	.885	.900	1.985	49.62
165100.	.930	.960	2.090	52.25
168200.	1.000	1.040	2.240	56.00
171600.	1.080	1.130	2.410	60.25
174000.	1.150	1.210	2.560	64.00
175600.	1.220	1.280	2.700	67.50
177000.	1.295	1.380	2.875	71.88
177700.	1.340	1.440	2.980	74.50
178700.	1.440	1.560	3.200	80.00
179000.	1.465	1.700	3.365	84.12
179000.	1.900	1.900	4.000	100.00

T = .1262 IN.
410658_T3 _7475 T61 _ _MAX_LOAD = 4.41_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
7100.	.185	.190	.575	14.37
16700.	.260	.255	.715	17.87
21300.	.305	.305	.810	20.25
24500.	.355	.355	.910	22.75
28300.	.405	.405	1.010	25.25
33000.	.490	.495	1.185	29.62
35700.	.550	.555	1.305	32.62
38000.	.610	.615	1.425	35.63
39700.	.670	.675	1.545	38.63
42100.	.755	.755	1.710	42.75
43800.	.830	.825	1.855	46.38
45200.	.905	.880	1.985	49.62
46500.	1.000	.975	2.175	54.38
47500.	1.085	1.040	2.325	58.13
48200.	1.170	1.135	2.505	62.63
48800.	1.295	1.240	2.735	68.38
49400.	1.585	1.480	3.265	81.63
49400.	1.900	1.900	4.000	100.00

.125IN T-L CN SPEC HUMID AIR,RT 13.3HZ

T = .1260 IN.
410658_T4 _7475 T61 _ _MAX_LOAD = 4.36_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.135	.165	.500	12.50
14400.	.185	.225	.610	15.25
25300.	.240	.285	.725	18.12
34900.	.310	.350	.860	21.50
41900.	.380	.420	1.000	25.00
46900.	.435	.480	1.115	27.87
51700.	.505	.545	1.250	31.25
55600.	.570	.615	1.385	34.63
59200.	.650	.690	1.540	38.50
62300.	.730	.770	1.700	42.50
64600.	.810	.855	1.865	46.63
66500.	.900	.945	2.045	51.13
67800.	.960	1.035	2.195	54.88
68600.	1.020	1.085	2.305	57.63
69600.	1.100	1.150	2.450	61.25
70900.	1.200	1.260	2.660	66.50
71800.	1.330	1.390	2.920	73.00
72600.	1.470	1.570	3.240	81.00
72900.	1.560	1.715	3.475	86.87
72900.	1.900	1.900	4.000	100.00

T = .1260 IN.
410658_T5 _7475 T61 _ _MAX_LOAD = 4.40_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
7000.	.210	.215	.625	15.63
9700.	.275	.285	.760	19.00
11500.	.325	.330	.855	21.38
13100.	.385	.390	.975	24.37
14900.	.455	.460	1.115	27.87
16200.	.525	.530	1.255	31.38
17100.	.595	.600	1.395	34.87
18100.	.665	.670	1.535	38.37
18900.	.735	.740	1.675	41.88
19700.	.815	.835	1.850	46.25
20400.	.910	.930	2.040	51.00
21400.	1.035	1.075	2.310	57.75
22100.	1.165	1.200	2.565	64.13
23100.	1.540	1.570	3.310	82.75
23100.	1.900	1.900	4.000	100.00

T = .1262 IN.
410658_T6 _7475 T61 _ _MAX_LOAD = 3.97_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
29800.	.195	.195	.590	14.75
49500.	.260	.250	.710	17.75
58300.	.310	.290	.800	20.00
73000.	.385	.375	.960	24.00
82800.	.465	.460	1.125	28.13
89000.	.535	.530	1.265	31.62
94300.	.600	.595	1.395	34.87
98800.	.675	.680	1.555	38.87
101300.	.730	.730	1.660	41.50
104100.	.800	.800	1.800	45.00
106600.	.870	.870	1.940	48.50
108400.	.930	.930	2.060	51.50
110100.	1.000	1.000	2.200	55.00
111300.	1.060	1.060	2.320	58.00
112400.	1.115	1.120	2.435	60.87
113500.	1.195	1.200	2.595	64.87
114300.	1.265	1.270	2.735	68.38
115100.	1.355	1.360	2.915	72.87
115800.	1.425	1.435	3.060	76.50
116400.	1.550	1.575	3.325	83.12
116800.	1.615	1.715	3.530	88.25
116800.	1.900	1.900	4.000	100.00

.125IN T-L CN SPEC SALT FOG,RT 13.3HZ

T = .1260 IN.
410658_T7 _7475 T61 _ _MAX_LOAD = 4.35_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.130	.170	.500	12.50
9800.	.185	.220	.605	15.13
16900.	.235	.275	.710	17.75
22100.	.285	.335	.820	20.50
26000.	.365	.390	.955	23.87
30300.	.425	.465	1.090	27.25
32500.	.470	.515	1.185	29.62
35900.	.550	.580	1.330	33.25
38500.	.605	.675	1.480	37.00
40300.	.655	.755	1.610	40.25
41800.	.755	.800	1.755	43.87
44600.	.905	.960	2.065	51.63
46200.	1.035	1.020	2.255	56.38
47200.	1.115	1.175	2.490	62.25
48900.	1.350	1.410	2.960	74.00
49600.	1.450	1.625	3.275	81.88
50000.	1.500	1.815	3.515	87.88
50000.	1.900	1.900	4.000	100.00

T = .1260 IN.
410658_T8 _7475 T61 _ _MAX_LOAD = 4.56_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.165	.135	.500	12.50
2700.	.220	.200	.620	15.50
4000.	.270	.250	.720	18.00
5600.	.330	.310	.840	21.00
6900.	.390	.370	.960	24.00
7700.	.440	.420	1.060	26.50
8500.	.500	.480	1.180	29.50
9200.	.560	.540	1.300	32.50
9800.	.620	.600	1.420	35.50
10500.	.680	.660	1.540	38.50
11300.	.760	.740	1.700	42.50
12200.	.870	.850	1.920	48.00
12800.	.970	.950	2.120	53.00
13300.	1.050	1.025	2.275	56.88
14200.	1.320	1.265	2.785	69.63
14600.	1.590	1.440	3.230	80.75
14600.	1.900	1.900	4.000	100.00

T = .1262 IN.
410658_T9 _7475 T61 _ _MAX_LOAD = 3.96_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.140	.160	.500	12.50
15700.	.190	.210	.600	15.00
29100.	.270	.290	.760	19.00
33700.	.320	.340	.860	21.50
37100.	.370	.390	.960	24.00
40900.	.420	.440	1.060	26.50
44600.	.475	.495	1.170	29.25
50900.	.625	.645	1.470	36.75
53800.	.720	.740	1.660	41.50
55400.	.780	.805	1.785	44.62
56600.	.840	.860	1.900	47.50
58000.	.910	.930	2.040	51.00
59400.	1.000	1.020	2.220	55.50
60200.	1.060	1.080	2.340	58.50
61200.	1.150	1.180	2.530	63.25
62300.	1.280	1.310	2.790	69.75
63200.	1.425	1.460	3.085	77.13
63900.	1.595	1.655	3.450	86.25
64000.	1.640	1.725	3.565	89.13
64000.	1.900	1.900	4.000	100.00

.125IN L-T CN SPEC DRY AIR,RT 13.3HZ

T = .1261 IN.
410658_L1 _7475 T61 _ _MAX_LOAD = 4.35_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
47800.	.200	.200	.600	15.00
86400.	.260	.270	.730	18.25
106600.	.300	.310	.810	20.25
124200.	.355	.360	.915	22.87
146700.	.450	.460	1.110	27.75
157300.	.505	.520	1.225	30.62
163500.	.550	.570	1.320	33.00
171500.	.600	.630	1.430	35.75
177500.	.660	.700	1.560	39.00
182600.	.710	.740	1.650	41.25
186600.	.760	.800	1.760	44.00
190700.	.820	.860	1.880	47.00
194400.	.875	.900	1.975	49.37
197900.	.940	.975	2.115	52.88
200900.	1.000	1.045	2.245	56.13
203400.	1.050	1.100	2.350	58.75
205600.	1.110	1.160	2.470	61.75
208200.	1.175	1.225	2.600	65.00
210500.	1.235	1.290	2.725	68.12
213000.	1.310	1.380	2.890	72.25
214900.	1.390	1.465	3.055	76.38
216200.	1.490	1.620	3.310	82.75
216600.	1.710	1.900	3.810	95.25

.125IN L-T CN SPEC HUMID AIR,RT 13.3HZ

T = .1259 IN.
410658_L2 _7475 T61 _ _MAX_LOAD = 4.36_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	12.50
18100.	.215	.200	.615	15.37
28400.	.265	.255	.720	18.00
34400.	.315	.305	.820	20.50
40700.	.375	.365	.940	23.50
44800.	.430	.415	1.045	26.13
48800.	.490	.475	1.165	29.12
52400.	.550	.535	1.285	32.12
55300.	.615	.605	1.420	35.50
58900.	.705	.690	1.595	39.88
60900.	.780	.765	1.745	43.62
63300.	.870	.860	1.930	48.25
65600.	.980	.975	2.155	53.88
66500.	1.055	1.050	2.305	57.63
67400.	1.140	1.145	2.485	62.12
68400.	1.240	1.250	2.690	67.25
69100.	1.325	1.335	2.860	71.50
69700.	1.435	1.455	3.090	77.25
70500.	1.655	1.715	3.570	89.25
70500.	1.900	1.900	4.000	100.00

.125IN L-T CN SPEC SALT FOG,RT 13.3HZ

T = .1256 IN.
410658_L3 _7475 T61 _ _MAX_LOAD = 4.34_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	12.50
9700.	.200	.205	.605	15.13
16600.	.245	.250	.695	17.37
21300.	.300	.295	.795	19.88
26700.	.375	.355	.930	23.25
30700.	.445	.435	1.080	27.00
33000.	.490	.510	1.200	30.00
35400.	.580	.550	1.330	33.25
38300.	.705	.640	1.545	38.63
39900.	.770	.725	1.695	42.38
41500.	.825	.840	1.865	46.63
43700.	.985	.950	2.135	53.38
45200.	1.125	1.090	2.415	60.37
45900.	1.225	1.185	2.610	65.25
46800.	1.365	1.340	2.905	72.63
47800.	1.590	1.480	3.270	81.75
48200.	1.705	1.635	3.540	88.50
48200.	1.900	1.900	4.000	100.00

NOTES: CN = Center Notch Specimen, Fig. 22.
Crack lengths are averages of readings on front and back surface; total notch length includes machined flaw of 0.20 in.

T = Specimen thickness.

TABLE LXXXII

FATIGUE CRACK GROWTH DATA FOR 7475-T761 SHEET
Constant Load Tests, Stress Ratio = + 1/3

(F33615-71-C-1571)

.040IN T-L CN SPEC DRY AIR,RT 13.3HZ

T = .0420 IN.
410664_T1 _7475 T761_ _MAX_LOAD = 1.44_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	12.50
67500.	.215	.200	.615	15.37
103400.	.275	.260	.735	18.38
124100.	.325	.310	.835	20.88
145600.	.385	.370	.955	23.87
168900.	.485	.470	1.155	28.88
178700.	.535	.520	1.255	31.38
187700.	.585	.570	1.355	33.88
195500.	.640	.620	1.460	36.50
204400.	.705	.690	1.595	39.88
210100.	.755	.740	1.695	42.38
214800.	.805	.790	1.795	44.87
219500.	.855	.840	1.895	47.38
223600.	.910	.895	2.005	50.13
228200.	.970	.960	2.130	53.25
231600.	1.030	1.015	2.245	56.13
234900.	1.095	1.085	2.380	59.50
237300.	1.155	1.145	2.500	62.50
240100.	1.230	1.220	2.650	66.25
242000.	1.295	1.280	2.775	69.38
244300.	1.405	1.370	2.975	74.37
245700.	1.475	1.455	3.130	78.25
246600.	1.675	1.900	3.775	94.38

.040IN T-L CN SPEC HUMID AIR,RT 13.3HZ

T = .0420 IN.
410664_T2 _7475 T761_ _MAX_LOAD = 1.44_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
29100.	.200	.210	.610	15.25
42500.	.250	.260	.710	17.75
66100.	.395	.400	.995	24.87
72700.	.450	.450	1.100	27.50
78100.	.500	.500	1.200	30.00
82300.	.550	.550	1.300	32.50
86800.	.610	.610	1.420	35.50
89900.	.660	.660	1.520	38.00
94500.	.740	.750	1.690	42.25
97100.	.805	.810	1.815	45.37
98700.	.860	.875	1.935	48.37
100700.	.920	.940	2.060	51.50
102800.	1.000	1.020	2.220	55.50
104500.	1.070	1.090	2.360	59.00
106000.	1.150	1.170	2.520	63.00
106900.	1.200	1.230	2.630	65.75
107800.	1.270	1.310	2.780	69.50
108600.	1.350	1.410	2.960	74.00
109300.	1.440	1.485	3.125	78.13
109800.	1.665	1.900	3.765	94.13

.040IN T-L CN SPEC SALT FOG,RT 13.3HZ

T = .0420 IN.
410664_T3 _7475 T761_ _MAX_LOAD = 1.45_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	12.50
10700.	.215	.205	.620	15.50
17300.	.290	.285	.775	19.38
21200.	.350	.345	.895	22.37
25000.	.405	.395	1.000	25.00
28400.	.460	.460	1.120	28.00
31200.	.525	.520	1.245	31.12
33500.	.585	.580	1.365	34.13
36000.	.655	.650	1.505	37.62
37600.	.725	.720	1.645	41.13
39300.	.775	.770	1.745	43.62
41300.	.860	.840	1.900	47.50
42600.	.920	.910	2.030	50.75
43800.	1.010	.975	2.185	54.62
45000.	1.070	1.030	2.300	57.50
46100.	1.150	1.120	2.470	61.75
46900.	1.220	1.180	2.600	65.00
47700.	1.290	1.250	2.740	68.50
48500.	1.410	1.370	2.980	74.50
49100.	1.560	1.500	3.260	81.50
49400.	1.900	1.765	3.865	96.62

.125IN T-L CN SPEC DRY AIR,RT 13.3HZ

T = .1255 IN.
410620_T1 _7475 T761_ _MAX_LOAD = 4.33_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
28900.	.200	.200	.600	15.00
64800.	.250	.250	.700	17.50
86800.	.300	.300	.800	20.00
106700.	.350	.355	.905	22.63
120700.	.405	.405	1.010	25.25
139800.	.500	.510	1.210	30.25
146300.	.555	.555	1.310	32.75
154300.	.600	.605	1.405	35.13
158600.	.645	.655	1.500	37.50
163800.	.695	.705	1.600	40.00
169900.	.755	.770	1.725	43.12
174900.	.820	.835	1.855	46.38
181000.	.905	.930	2.035	50.87
182800.	.955	.970	2.125	53.13
185600.	1.000	1.020	2.220	55.50
188700.	1.080	1.110	2.390	59.75
191300.	1.150	1.190	2.540	63.50
194000.	1.255	1.290	2.745	68.63
195900.	1.345	1.380	2.925	73.13
196900.	1.420	1.480	3.100	77.50
197900.	1.510	1.570	3.280	82.00
198500.	1.620	1.700	3.520	88.00

T = .1262 IN.
410620_T2 _7475 T761_ _MAX_LOAD = 6.61_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.190	.180	.570	14.25
7000.	.245	.235	.680	17.00
12300.	.305	.290	.795	19.88
17400.	.365	.350	.915	22.87
20700.	.415	.400	1.015	25.37
24300.	.475	.465	1.140	28.50
26900.	.530	.525	1.255	31.38
30000.	.600	.595	1.395	34.87
32500.	.660	.655	1.515	37.87
34400.	.720	.715	1.635	40.88
36700.	.790	.775	1.765	44.12
38200.	.850	.830	1.880	47.00
39300.	.905	.880	1.985	49.62
40600.	.975	.960	2.135	53.38
41400.	1.045	1.025	2.270	56.75
42400.	1.130	1.110	2.440	61.00
43100.	1.230	1.195	2.625	65.63
43700.	1.365	1.300	2.865	71.62
44200.	1.610	1.455	3.265	81.62

T = .1259 IN.
410620_T3 _7475 T761_ _MAX_LOAD = 3.96_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
61000.	.200	.200	.600	15.00
96000.	.250	.250	.700	17.50
132600.	.300	.310	.810	20.25
152500.	.350	.360	.910	22.75
173300.	.400	.420	1.020	25.50
190000.	.450	.470	1.120	28.00
200800.	.500	.520	1.220	30.50
212700.	.560	.580	1.340	33.50
219200.	.600	.620	1.420	35.50
227500.	.650	.670	1.520	38.00
235600.	.720	.740	1.660	41.50
243600.	.795	.815	1.810	45.25
247500.	.840	.870	1.910	47.75
252800.	.910	.940	2.050	51.25
255700.	.970	1.000	2.170	54.25
259800.	1.040	1.075	2.315	57.88
262600.	1.100	1.140	2.440	61.00
265000.	1.160	1.200	2.560	64.00
267100.	1.220	1.270	2.690	67.25
269400.	1.295	1.360	2.855	71.38
271500.	1.385	1.480	3.065	76.63
272700.	1.480	1.630	3.310	82.75
273000.	1.685	1.900	3.785	94.63

.125IN T-L CN SPEC HUMID AIR,RT 13.3HZ

T = .1258 IN.
410620_T4 _7475 T761_ _MAX_LOAD = 4.35_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	12.50
32700.	.225	.215	.640	16.00
47600.	.275	.265	.740	18.50
64400.	.360	.350	.910	22.75
74400.	.430	.420	1.050	26.25
80500.	.480	.470	1.150	28.75
84600.	.535	.525	1.260	31.5
90800.	.615	.600	1.415	35.3
94500.	.675	.665	1.540	38.5
97800.	.745	.735	1.680	42.0
100100.	.800	.795	1.795	44.8
102200.	.860	.855	1.915	47.8
104400.	.945	.940	2.085	52.1
106000.	1.005	1.005	2.210	55.2
107400.	1.095	1.085	2.380	59.5
108800.	1.150	1.140	2.490	62.2
109700.	1.210	1.205	2.615	65.37
110700.	1.320	1.320	2.840	71.00
111900.	1.460	1.460	3.120	78.00
112900.	1.705	1.675	3.580	89.50

T = .1255 IN.
410620_T5 _7475 T761_ _MAX_LOAD = 6.60_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
5900.	.200	.200	.600	15.00
10200.	.265	.260	.725	18.12
13400.	.330	.320	.850	21.25
16200.	.390	.380	.970	24.25
18800.	.470	.460	1.130	28.25
20700.	.540	.530	1.270	31.75
22200.	.600	.600	1.400	35.00
23800.	.690	.690	1.580	39.50
24800.	.760	.760	1.720	43.00
25700.	.820	.820	1.840	46.00
26800.	.920	.920	2.040	51.00
27800.	1.020	1.020	2.240	56.00
28500.	1.100	1.100	2.400	60.00
29300.	1.220	1.220	2.640	66.00
29900.	1.350	1.350	2.900	72.50
30300.	1.550	1.550	3.300	82.50

T = .1256 IN.
410620_T6 _7475 T761_ _MAX_LOAD = 3.96_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.140	.160	.500	12.50
20600.	.200	.220	.620	15.50
37900.	.235	.260	.695	17.37
75100.	.320	.320	.840	21.00
101600.	.425	.430	1.055	26.37
117500.	.525	.530	1.255	31.38
124500.	.585	.590	1.375	34.38
129000.	.635	.640	1.475	36.87
139200.	.775	.785	1.760	44.00
142900.	.860	.870	1.930	48.25
144500.	.910	.925	2.035	50.87
147100.	.990	1.005	2.195	54.88
150000.	1.080	1.110	2.390	59.75
151800.	1.165	1.195	2.560	64.00
153000.	1.235	1.270	2.705	67.62
154000.	1.295	1.325	2.820	70.50
154800.	1.360	1.400	2.960	74.00
155700.	1.430	1.490	3.120	78.00
156300.	1.515	1.570	3.285	82.13
157000.	1.620	1.900	3.720	93.00

.125IN T-L CN SPEC SALT FOG,RT 13.3HZ

T = .1256 IN.
410620_T7 _7475 T761_ _MAX_LOAD = 4.35_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.135	.165	.500	12.50
25200.	.245	.280	.725	18.12
32700.	.320	.355	.875	21.88
37500.	.370	.420	.990	24.75
40500.	.420	.470	1.090	27.25
43400.	.490	.530	1.220	30.50
46200.	.560	.600	1.360	34.00
48200.	.620	.660	1.480	37.00
49800.	.670	.710	1.580	39.50
51800.	.760	.800	1.760	44.00
53200.	.840	.880	1.920	48.00
54700.	.930	.970	2.100	52.50
55700.	1.010	1.050	2.260	56.50
56700.	1.100	1.150	2.450	61.25
57800.	1.240	1.270	2.710	67.75
58600.	1.325	1.390	2.915	72.88
59300.	1.455	1.520	3.175	79.38
60000.	1.605	1.690	3.495	87.38

T = .1256 IN.
410620_T8 _7475 T761_ _MAX_LOAD = 6.56_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
3400.	.210	.210	.620	15.50
5400.	.270	.270	.740	18.50
7200.	.330	.330	.860	21.50
8400.	.400	.400	1.000	25.00
9700.	.470	.470	1.140	28.50
10700.	.540	.540	1.280	32.00
11600.	.620	.620	1.440	36.00
12400.	.720	.720	1.640	41.00
13200.	.820	.815	1.835	45.87
14000.	.930	.920	2.050	51.25
14600.	1.035	1.020	2.255	56.38
15200.	1.130	1.105	2.435	60.88
15800.	1.330	1.275	2.805	70.13
16300.	1.565	1.410	3.175	79.38

T = .1258 IN.
410620_T9 _7475 T761_ _MAX_LOAD = 3.95_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	12.50
25800.	.220	.220	.640	16.00
42700.	.280	.280	.760	19.00
54200.	.370	.365	.935	23.37
60500.	.440	.435	1.075	26.87
66200.	.530	.525	1.255	31.38
69400.	.590	.585	1.375	34.38
72000.	.660	.655	1.515	37.87
74600.	.720	.720	1.640	41.00
76400.	.790	.790	1.780	44.50
77600.	.850	.850	1.900	47.50
79200.	.930	.930	2.060	51.50
80300.	.990	.990	2.180	54.50
81400.	1.060	1.060	2.320	58.00
82300.	1.130	1.130	2.460	61.50
83100.	1.200	1.200	2.600	65.00
83700.	1.280	1.280	2.760	69.00
84300.	1.380	1.380	2.960	74.00
84800.	1.440	1.440	3.080	77.00
85400.	1.600	1.600	3.400	85.00
85600.	1.680	1.700	3.580	89.50

.125IN L-T CN SPEC DRY AIR,RT 13.3HZ

T = .1260 IN.
410620_L1 _7475 T761_ _MAX_LOAD = 4.35_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.160	.140	.500	12.50
56600.	.210	.200	.610	15.25
96200.	.275	.260	.735	18.38
124500.	.345	.335	.880	22.00
142100.	.395	.380	.975	24.37
156300.	.460	.440	1.100	27.50
166600.	.520	.500	1.220	30.50
175100.	.570	.550	1.320	33.00
184300.	.630	.600	1.430	35.75
193400.	.690	.665	1.555	38.87
200500.	.755	.735	1.690	42.25
205200.	.810	.790	1.800	45.00
209600.	.870	.850	1.920	48.00
213600.	.930	.910	2.040	51.00
217700.	1.000	.980	2.180	54.50
220700.	1.070	1.050	2.320	58.00
224500.	1.160	1.125	2.485	62.12
227700.	1.240	1.190	2.630	65.75
229700.	1.300	1.235	2.735	68.38
231600.	1.365	1.300	2.865	71.62
233100.	1.435	1.370	3.005	75.13
234200.	1.515	1.425	3.140	78.50
235100.	1.635	1.505	3.340	83.50
235600.	1.900	1.680	3.780	94.50

.125IN L-T CN SPEC HUMID AIR,RT 13.3HZ

T = .1260 IN.
410620_L2 _7475 T761_ _MAX_LOAD = 4.32_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.160	.140	.500	12.50
32200.	.210	.190	.600	15.00
57500.	.260	.240	.700	17.50
73800.	.310	.295	.805	20.12
86000.	.360	.360	.920	23.00
93500.	.405	.400	1.005	25.13
99800.	.455	.450	1.105	27.63
107700.	.535	.515	1.250	31.25
111100.	.555	.545	1.300	32.50
115200.	.610	.600	1.410	35.25
118600.	.660	.660	1.520	38.00
120900.	.700	.715	1.615	40.38
125900.	.825	.825	1.850	46.25
128100.	.880	.890	1.970	49.25
131900.	1.015	1.060	2.275	56.88
132600.	1.060	1.080	2.340	58.50
134100.	1.145	1.160	2.505	62.63
136100.	1.260	1.295	2.755	68.88
136900.	1.335	1.385	2.920	73.00
137800.	1.460	1.515	3.175	79.38

.125IN L-T CN SPEC SALT FOG,RT 13.3HZ

T = .1260 IN.
410620_L3 _7475 T761_ _MAX_LOAD = 4.35_KIPS

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.160	.140	.500	12.50
15000.	.200	.200	.600	15.00
28100.	.260	.255	.715	17.87
36000.	.370	.350	.920	23.00
40500.	.435	.445	1.080	27.00
42700.	.500	.495	1.195	29.88
45200.	.565	.570	1.335	33.38
47700.	.650	.650	1.500	37.50
49100.	.700	.700	1.600	40.00
51200.	.800	.800	1.800	45.00
53500.	.850	.855	1.905	47.62
55900.	.985	1.015	2.200	55.00
57000.	1.060	1.095	2.355	58.88
58000.	1.155	1.195	2.550	63.75
58900.	1.250	1.300	2.750	68.75
59600.	1.350	1.400	2.950	73.75
59900.	1.400	1.500	3.100	77.50
60600.	1.565	1.635	3.400	85.00
60700.	1.635	1.720	3.555	88.88

NOTES: CN = Center Notch Specimen, Fig. 22.
Crack lengths are averages of readings on front and back surfaces; total notch length includes machined flaw of 0.20 in.

T = Specimen thickness.

TABLE LXXXIII

FATIGUE CRACK GROWTH DATA FOR 2144-T851 PLATE
Constant Load Tests, Stress Ratio = + 1/3

(F33615-71-C-1571)

2.0IN T-L CN SPEC DRY AIR,RT 5.2HZ

410680LTE1_2124T851 - MAX LOAD =18.60 KIPS; T = .7505 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.145	.155	.500	16.63
36700.	.185	.195	.580	19.29
72900.	.245	.245	.690	22.95
102900.	.300	.295	.795	26.44
120700.	.350	.345	.895	29.76
134500.	.410	.395	1.005	33.42
148000.	.470	.440	1.110	36.91
156900.	.530	.490	1.220	40.57
165000.	.590	.545	1.335	44.40
172200.	.660	.600	1.460	48.55
177000.	.715	.645	1.560	51.88
180000.	.765	.680	1.645	54.71
184400.	.860	.745	1.805	60.03
186600.	.925	.800	1.925	64.02
188400.	1.010	.855	2.065	68.67
189500.	1.135	.905	2.240	74.49

2.0IN T-L CN SPEC HUMID AIR,RT 5.2HZ

410680LTE2_2124T851 - MAX LOAD =18.57 KIPS; T = .7505 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.140	.160	.500	16.64
46600.	.205	.195	.600	19.97
73000.	.260	.240	.700	23.30
92700.	.310	.290	.800	26.63
107400.	.355	.345	.900	29.96
118900.	.405	.395	1.000	33.29
127700.	.450	.450	1.100	36.62
136300.	.495	.500	1.195	39.78
143800.	.550	.545	1.295	43.11
149800.	.600	.615	1.415	47.10
154400.	.660	.665	1.525	50.77
157900.	.720	.715	1.635	54.43
161800.	.795	.790	1.785	59.42
163600.	.845	.840	1.885	62.75
164400.	.905	.895	2.000	66.58
165600.	.970	.965	2.135	71.07
165800.	1.030	1.035	2.265	75.40

2.0IN T-L CN SPEC SALT FOG,RT 5.2HZ

410680LTE3_2124T851 - MAX LOAD =18.53 KIPS; T = .7506 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.67
71100.	.220	.230	.650	21.67
117200.	.375	.375	.950	31.67
132000.	.515	.515	1.230	41.00
139400.	.600	.595	1.395	46.50
145700.	.675	.665	1.540	51.33
148400.	.750	.750	1.700	56.67
153800.	.905	.915	2.020	67.33
154600.	.965	.975	2.140	71.33
154900.	1.000	1.005	2.205	73.50

4.5IN T-L CN SPEC DRY AIR,RT 5.2HZ

410683LTEC_2124T851 - MAX LOAD =18.51 KIPS; T = .7500 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.155	.145	.500	16.67
34300.	.175	.185	.560	18.67
110500.	.235	.220	.655	21.83
146300.	.285	.270	.755	25.17
173200.	.330	.320	.850	28.33
196300.	.375	.365	.940	31.33
213800.	.425	.410	1.035	34.50
235300.	.470	.465	1.135	37.83
249900.	.520	.510	1.230	41.00
267100.	.575	.565	1.340	44.67
282600.	.640	.615	1.455	48.50
292100.	.690	.675	1.565	52.17
297400.	.730	.725	1.655	55.17
304300.	.785	.780	1.765	58.83
309400.	.835	.830	1.865	62.17
312500.	.895	.890	1.985	66.17
314700.	.935	.940	2.075	69.17
316400.	1.000	1.000	2.200	73.33
316800.	1.040	1.055	2.295	76.50
317400.	1.115	1.170	2.485	82.83

410683LTE2_2124T851 - MAX LOAD =30.27 KIPS; T = .7497 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.140	.160	.500	16.64
15700.	.215	.230	.645	21.47
23300.	.265	.280	.745	24.80
29100.	.300	.310	.810	26.96
37900.	.375	.385	.960	31.96
43300.	.440	.445	1.085	36.12
45900.	.490	.490	1.180	39.28
49000.	.545	.540	1.285	42.78
50800.	.595	.590	1.385	46.11
51800.	.650	.635	1.485	49.43
52800.	.710	.690	1.600	53.26
53200.	.755	.730	1.685	56.09
53400.	.845	.800	1.845	61.42

410683LTE3_2124T851 - MAX LOAD =18.55 KIPS; T = .7500 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.165	.135	.500	16.66
43800.	.215	.175	.590	19.65
86800.	.260	.225	.685	22.82
110800.	.300	.250	.750	24.98
141900.	.350	.310	.860	28.65
161500.	.400	.355	.955	31.81
182700.	.480	.410	1.080	35.98
195800.	.535	.445	1.180	39.31
209600.	.605	.500	1.305	43.47
221300.	.665	.550	1.415	47.14
229100.	.715	.590	1.505	50.13
236200.	.765	.640	1.605	53.46
241800.	.825	.670	1.695	56.46
244000.	.880	.740	1.835	61.13
253500.	.975	.785	1.960	65.29
256500.	1.045	.835	2.080	69.29
258000.	1.140	.880	2.220	73.95
258400.	1.195	.905	2.300	76.62

4.5IN T-L CN SPEC HUMID AIR,RT 5.2HZ

410683LTE4_2124T851 - MAX LOAD =18.54 KIPS; T = .7492 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.64
28300.	.170	.170	.540	17.97
71800.	.210	.220	.630	20.97
106300.	.265	.265	.730	24.29
126700.	.320	.315	.835	27.79
149700.	.380	.385	.965	32.11
158200.	.425	.445	1.070	35.61
163800.	.475	.465	1.140	37.94
176300.	.520	.530	1.250	41.60
183200.	.575	.575	1.350	44.93
190500.	.635	.645	1.480	49.25
194600.	.680	.695	1.575	52.41
199200.	.760	.740	1.700	56.57
202800.	.830	.825	1.855	61.73
204300.	.885	.880	1.965	65.39
206400.	.960	.915	2.075	69.05
207500.	1.115	1.030	2.345	78.04

410683LTE5_2124T851 - MAX LOAD =30.30 KIPS; T = .7502 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.64
9400.	.200	.200	.600	19.97
16600.	.255	.255	.710	23.64
21800.	.310	.320	.830	27.63
26400.	.365	.375	.940	31.29
29600.	.425	.435	1.060	35.29
31000.	.475	.480	1.155	38.45
32800.	.530	.535	1.265	42.11
33900.	.575	.590	1.365	45.44
34600.	.625	.655	1.480	49.27
35300.	.685	.700	1.585	52.76
35900.	.770	.835	1.805	60.09
36000.	.790	.850	1.840	61.25

410683LTE6_2124T851 - MAX LOAD =18.51 KIPS; T = .7499 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.67
73300.	.195	.205	.600	20.00
111400.	.250	.255	.705	23.50
130800.	.305	.295	.800	26.67
150000.	.350	.350	.900	30.00
167500.	.400	.400	1.000	33.33
186100.	.500	.500	1.200	40.00
196400.	.550	.550	1.300	43.33
201100.	.600	.600	1.400	46.67
205600.	.655	.645	1.500	50.00
209100.	.710	.690	1.600	53.33
212500.	.755	.745	1.700	56.67
216800.	.800	.800	1.800	60.00
218300.	.875	.870	1.945	64.83
219600.	.925	.910	2.035	67.83
220500.	.990	.955	2.145	71.50
221000.	1.040	.990	2.230	74.33
221200.	1.075	1.050	2.325	77.50

4.5IN T-L CN SPEC SALT FOG,RT 5.2HZ

410683LTE7_2124T851 - MAX LOAD =18.69 KIPS; T = .7500 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.145	.155	.500	16.64
185000.	.210	.190	.600	19.97
391100.	.260	.245	.705	23.46
479900.	.350	.345	.895	29.78
481500.	.400	.400	1.000	33.28
542600.	.475	.425	1.100	36.61
563200.	.505	.495	1.200	39.93
570000.	.600	.525	1.325	44.09
574400.	.650	.600	1.450	48.25
580600.	.750	.700	1.650	54.91
586900.	.925	.875	2.000	66.56
588400.	1.265	1.075	2.540	84.53

410683LTE8_2124T851 - MAX LOAD =30.31 KIPS; T = .7517 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.66
8900.	.200	.200	.600	19.99
15800.	.275	.270	.745	24.82
20600.	.350	.340	.890	29.65
24000.	.445	.440	1.085	36.14
26500.	.515	.505	1.220	40.64
28000.	.575	.575	1.350	44.97
29600.	.645	.645	1.490	49.63
30300.	.815	.785	1.800	59.96
30600.	.935	.920	2.055	68.45

410683LTF92124T851 - MAX LOAD =18.57 KIPS; T = .7513 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.66
47000.	.210	.215	.625	20.82
75100.	.260	.250	.710	23.65
89700.	.295	.280	.775	25.82
109500.	.340	.320	.860	28.65
127600.	.390	.380	.970	32.31
145100.	.480	.470	1.150	38.31
151200.	.540	.540	1.280	42.64
156800.	.620	.595	1.415	47.14
161100.	.685	.670	1.555	51.80
166100.	.790	.715	1.705	56.80
171100.	.900	.845	1.945	64.79
172800.	1.010	.980	2.190	72.95
173600.	1.125	1.000	2.325	77.45

4.5IN L-T CN SPEC DRY AIR,RT 5.2HZ

410683_LE1_2124T851 - MAX LOAD =18.57 KIPS; T = .7496 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.160	.140	.500	16.64
80500.	.200	.200	.600	19.97
110400.	.225	.230	.655	21.80
157400.	.275	.260	.735	24.46
192100.	.325	.310	.835	27.79
220300.	.375	.345	.920	30.62
250100.	.430	.390	1.020	33.94
282800.	.480	.440	1.120	37.27
305000.	.535	.495	1.230	40.93
318100.	.585	.530	1.315	43.76
338300.	.635	.590	1.425	47.42
358100.	.710	.660	1.570	52.25
372200.	.795	.725	1.720	57.24
383000.	.875	.780	1.855	61.73
390000.	.955	.830	1.985	66.06
394300.	1.010	.870	2.080	69.22
397300.	1.095	.910	2.205	73.38
398700.	1.155	.945	2.300	76.54
399300.	1.210	.965	2.375	79.03
399600.	1.240	.980	2.420	80.53

4.5IN L-T CN SPEC HUMID AIR,RT 5.2HZ

410683_LE2_2124T851 - MAX LOAD =18.59 KIPS; T = .7500 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.61
88700.	.200	.200	.600	19.93
135700.	.255	.245	.700	23.26
188000.	.310	.305	.815	27.08
209500.	.365	.375	.940	31.23
233400.	.435	.445	1.080	35.88
242800.	.495	.480	1.175	39.04
253200.	.540	.530	1.270	42.19
260500.	.590	.585	1.375	45.68
268900.	.655	.645	1.500	49.83
274900.	.715	.710	1.625	53.99
279300.	.770	.765	1.735	57.64
284000.	.840	.835	1.875	62.29
287000.	.895	.890	1.985	65.95
290500.	.975	.985	2.160	71.76
293200.	1.050	1.090	2.340	77.74
294300.	1.200	1.210	2.610	86.71

4.5IN L-T CN SPEC SALT FOG,RT 5.2HZ

410683_LE3_2124T851 - MAX LOAD =18.57 KIPS; T = .7495 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) AVG. LEFT	AVG. RIGHT	TOTAL NOTCH LENGTH (IN.)	PERCENT CRACKED
0.	.150	.150	.500	16.64
82900.	.200	.200	.600	19.97
95300.	.240	.260	.700	23.29
135500.	.340	.340	.880	29.28
171700.	.390	.390	.980	32.61
184100.	.450	.450	1.100	36.61
195700.	.510	.510	1.220	40.60
218000.	.665	.670	1.535	51.08
227100.	.795	.790	1.785	59.40
230500.	.870	.860	1.930	64.23
233700.	.950	.940	2.090	69.55
235000.	1.040	1.025	2.265	75.37
237400.	1.165	1.115	2.480	82.53
237700.	1.200	1.120	2.520	83.86

4.5IN S-L CT SPEC DRY AIR,RT 18.3HZ

410683_SL1_2124T851 - MAX LOAD = 3.91 KIPS; T = 1.4890 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.180	1.190	31.1
29400.	1.220	1.240	32.3
58400.	1.270	1.300	33.8
75400.	1.320	1.350	35.1
97300.	1.380	1.420	36.8
117600.	1.440	1.470	38.2
143200.	1.500	1.540	39.9
154000.	1.550	1.590	41.3
166700.	1.600	1.630	42.4
178200.	1.650	1.680	43.8
190500.	1.700	1.730	45.1
209700.	1.770	1.800	46.9
221900.	1.820	1.850	48.2
233900.	1.870	1.900	49.5
243700.	1.920	1.950	50.9
252500.	1.970	2.000	52.2
259500.	2.020	2.050	53.5
266000.	2.070	2.100	54.8
271400.	2.120	2.150	56.1
274800.	2.160	2.190	57.2
276900.	2.210	2.250	58.6
278600.	2.260	2.300	59.9
280100.	2.320	2.390	61.9
280800.	2.360	2.430	62.9
281000.	2.400	2.480	64.1
281000.	3.810	3.810	100.1

4.5IN S-L CT SPEC HUMID AIR,RT 18.3HZ

410683_SL2_2124T851 - MAX LOAD = 3.89 KIPS; T = 1.4900 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.400	1.400	36.8
19700.	1.450	1.460	38.2
35800.	1.500	1.530	39.8
43500.	1.530	1.560	40.6
51000.	1.570	1.600	41.7
62500.	1.630	1.650	43.1
72100.	1.680	1.710	44.5
79900.	1.730	1.770	46.0
86000.	1.780	1.830	47.4
91800.	1.840	1.870	48.8
99000.	1.920	1.950	50.9
103500.	1.970	2.000	52.2
106800.	2.030	2.060	53.7
110600.	2.090	2.130	55.5
112700.	2.140	2.180	56.8
115000.	2.190	2.220	58.0
116800.	2.240	2.270	59.3
118200.	2.290	2.310	60.4
119500.	2.350	2.400	62.4
120400.	2.400	2.450	63.7
121100.	2.530	2.580	67.1
121100.	3.810	3.810	100.1

4.5IN S-L CT SPEC SALT FOG,RT 18.3HZ

410683_SL3_2124T851 - MAX LOAD = 3.90 KIPS; T = 1.4910 IN.

CYCLES	FATIGUE CRACK LENGTH (IN.) FRONT	BACK	PERCENT CRACKED
0.	1.450	1.410	37.6
46800.	1.490	1.470	38.9
58600.	1.490	1.570	40.2
63900.	1.650	1.590	42.6
75400.	1.700	1.670	44.3
83200.	1.750	1.720	45.6
91300.	1.800	1.770	46.9
95100.	1.850	1.820	48.2
104000.	1.900	1.870	49.5
109300.	1.950	1.920	50.9
113000.	2.020	1.980	52.6
116000.	2.070	2.010	53.6
120500.	2.120	2.060	54.9
123100.	2.160	2.130	56.4
124900.	2.210	2.170	57.6
127200.	2.280	2.230	59.3
130400.	2.330	2.300	60.8
131600.	2.380	2.350	62.2
133000.	2.420	2.430	63.7
134000.	2.500	2.480	65.4
134100.	3.810	3.810	100.1

NOTES: CN = Center Notch Specimen, Fig. 23.
Crack lengths are average readings on front and back surface; total notch length includes machined flaw of 0.20 in.

CT = Compact Tension Crack Growth Specimen, Fig. 24.
Crack lengths are measured from load line.

T = Specimen thickness.

REFERENCES

1. G. W. Stickley and D. J. Brownhill, "Mechanical Properties of Stress-Relieved Stretched Aluminum Alloy Plate", Technical Report AFML-TDR-64-105, May, 1964.

2. J. G. Kaufman, G. E. Nordmark and B. W. Lifka, "Fracture Toughness, Fatigue and Corrosion Characteristics of 7075-T651, 7075-T7351 and 7079-T651 Aluminum Alloys", Technical Report AFML-TR-65-170, May, 1965.

3. J. G. Kaufman, G. E. Nordmark and B. W. Lifka, "Fracture Toughness, Fatigue and Corrosion Characteristics of 2020-T651, 2024-T851, 2219-T851 and 7001-T75 Aluminum Alloys", Technical Report AFML-TR-66-291, September, 1966.

4. D. J. Brownhill, R. E. Davies and D. O. Sprowls, "Mechanical Properties, Including Fracture Toughness and Fatigue, and Resistance to Stress Corrosion Cracking, of Stress-Relieved Stretched Aluminum Alloy Extrusions", Technical Report AFML-TR-68-34, February, 1968.

5. D. J. Brownhill, C. F. Babilon, G. E. Nordmark and D. O. Sprowls, "Mechanical Properties Including Fracture Toughness and Fatigue, Corrosion Characteristics and Fatigue Crack Propagation Rates of Stress-Relieved Aluminum Alloy Hand Forgings", Technical Report AFML-TR-70-10, February, 1970.

6. Military Standardization Handbook, Metallic Materials and Elements for Aerospace Vehicle Structures, Volume 1, September 1, 1971.

7. "Aluminum Standards and Data", The Aluminum Association, 1972-73.

8. "Federal Test Method Standard No. 151b", November 1967.

9. "Standard Methods of Verification of Testing Machines, E4-64", 1972 Book of ASTM Standards, Part 31.

10. "Standard Methods of Tension Testing of Metallic Materials, E8-68", 1972 Book of ASTM Standards, Part 31.

11. "Standard Methods of Compression Testing of Metallic Materials, E9-67", 1972 Book of ASTM Standards, Part 31.

12. R. E. Davies and J. G. Kaufman, "Effects of Test Method and Specimen Orientation on Shear Strengths of Aluminum Alloys", ASTM Proceedings, Vol. 64, 1964, pp. 999-1010.

13. "Standard Method for Pin-Type Bearing Test of Metallic Materials, E238-68", 1972 Book of ASTM Standards, Part 31.

14. "Standard Method for Determination of Young's Modulus at Room Temperature, E111-61", 1972 Book of ASTM Standards, Part 31.

REFERENCES

(Continued)

15. "Standard Method of Verification and Classification of Extensometers, E83-67", 1972 Book of ASTM Standards, Part 31.

16. D. P. Moon and W. S. Hyler, "MIL_HDBK-5 Guidelines for Presentation of Data", Technical Report AFML-TR-66-386, February, 1967.

17. "Standard Method of Test for Plane-Strain Fracture Toughness of Metallic Materials, E399-72", 1972 Book of ASTM Standards, Part 31.

18. J. G. Kaufman and A. H. Knoll, "Kahn-Type Tear Tests and Crack Toughness of Aluminum Sheet," Materials Research and Standards, Vol. 4, No. 4, April 1964, pp. 151-155.

19. "Fracture Testing of High Strength Sheet Materials", ASTM Bulletin No. 243, January 1960, p. 29; also No. 244, February 1960, p. 18.

20. C. E. Fedderson, "Evaluation and Prediction of the Residual Strength of Center-Cracked Tension Panels," Battelle Memorial Institute, Columbus, Ohio (presented at the ASTM Annual Meeting, Toronto, Canada, June, 1970).

21. R. H. Heyer and D. F. McCabe, "Plane Stress Fracture Toughness Testing Using a Crack-Line Loaded Specimen", Progress Report for Meeting of Subcommittee I of ASTM Committee E24, March 26, 1969; National Symposium of Fracture Mechanics, Lehigh University, August, 1969.

22. C. E. Jasko, C. E. Fedderson and K. B. Davies, "Analysis of Fatigue, Fatigue-Crack Propagation and Fracture Data," Quarterly Progress Report, May 19, 1972, sponsored by NASA Langley Research Center.

23. W. F. Brown, Jr. and J. E. Srawley, "Plane Strain Crack Toughness Testing of High Strength Metallic Materials", ASTM STP No. 410, 1967.

24. W. G. Clark, Jr., ASTM E24.4, "Fatigue Crack Growth Rate Testing Round Robin Program", Task Group Progress Report No. 3, May 14, 1971.

25. "Standard Method of Test for Exfoliation Corrosion Susceptibility in 7XXX Series Copper-Containing Aluminum Alloys (EXCO Tests)", G34-72, 1972 Book of ASTM Standards, Part 31.

REFERENCES
(Continued)

26. B. F. Brown, Naval Research Laboratory, Washington, D.C., "Stress-Corrosion Cracking in High Strength Steels and in Titanium and Aluminum Alloys", 1972.

    M. V. Hyatt and M. O. Speidel, "High Strength Aluminum Alloys", ARPA Order No. 878.

27. C. L. Harmsworth, "Evaluation of Landing Gears Fabrication from 7175-T736 and 7049-T73 Aluminum Alloys", May 25, 1972.

28. R. E. Jones, "Fracture Toughness and Fatigue Crack Growth Properties of 7175-T736 Aluminum Alloy Forgings at Several Temperatures", Technical Report AFML-TR-72-1, February, 1972.

29. K. J. Oswalt, "Engineering Property Evaluation of 7049-T73 Die Forged Material", Northrop Corporation Aircraft Division Report, March 5, 1971.

30. O. L. Deel and H. Mindlin, "Engineering Data on New and Emerging Structural Materials", Technical Report AFML-TR-70-252, October 1970.

31. R. R. Cervay, "Engineering Design Data for Aluminum Alloy 7475 in the T761 and T61 Condition", Technical Report AFML-TR-72-173, September 1972.

32. D. Y. Wang, "Plane-Stress Fracture Toughness and Fatigue Crack Propagation of Aluminum Alloy Wide Panels; Douglas Aircraft Company Paper 6054.

33. D. E. McCabe and R. H. Heyer, "Test Method -- Fracture Toughness Measured by Crack Growth Resistance; Armco-Research and Technology Report, February 25, 1971.

34. C. N. Freed, A. M. Sullivan and J. Stoop, "Crack-Growth Resistance Characteristics of High Strength Sheet Alloys", Naval Research Laboratory Report 7374, January 31, 1972.

35. A. F. Liu and J. M.Van Orden, "Evaluation of X7475-T61 Clad Sheet", Lockheed California Company, Report LR-24951, February, 1972.

REFERENCES
(Concluded)

36. G. E. Nordmark and J. G. Kaufman, "Fatigue-Crack Propagation Characteristics of Aluminum Alloys in Thick Sections," Engineering Fracture Mechanics, Vol. 4, pp. 193-204, 1972.

37. C. F. Lewis, "Statistics - A Useful Tool for the Examination of Corrosion Data", Corrosion, 9, No. 1, 38 (1953) January.

38. B. W. Lifka and D. O. Sprowls, "Stress Corrosion Testing", ASTM Special Technical Publication No. 425, 342 (1967).

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Aluminum Company of America	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

Mechanical Properties, Fracture Toughness, Fatigue, Environmental Fatigue Crack Growth Rates and Corrosion Characteristics of High-Toughness Aluminum Alloy Forgings, Sheet and Plate.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Final May 1971 - February 1973

5. AUTHOR(S) (Last name, first name, initial)

C. F. Babilon, R. H. Wygonik, G. E. Nordmark and B.W. Lifka

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
		38

8a. CONTRACT OR GRANT NO. F33615-71-C-1571	9a. ORIGINATOR'S REPORT NUMBER(S) --
b. PROJECT NO. 7381 c. 738106 d.	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFML-TR-73-83

10. AVAILABILITY/LIMITATION NOTICES

Approved for Public Release; Distribution Unlimited

11. SUPPLEMENTARY NOTES None	12. SPONSORING MILITARY ACTIVITY Air Force Materials Laboratory(MAAE) Air Force Systems Command Wright-Patterson Air Force Base, Ohio

13. ABSTRACT The mechanical properties, including toughness and fatigue, fatigue crack growth rates and corrosion characteristics have been determined for a total of 56 lots of 7049-T73 and 7175-T736 forgings, 7475-T61 and T761 sheet, and 2124-T851 plate. Supplemental data for bare and Alclad 7475 sheet and 2124-T851 plate are also presented.

Tables of computed design mechanical properties and typical stress-strain and compressive tangent modulus curves were prepared.

The plane-strain stress-intensity factor, K_{Ic}, was determined for the forging and plate samples and the critical stress-intensity factor, K_c, determined for the sheet samples.

Log-mean fatigue lives were calculated from tests made in ambient air. Axial-stress fatigue tests were also made in a salt fog environment.

The rates of fatigue crack propagation of these products generally do not vary significantly with specimen orientation. Humid and salt fog environments increased the rate of fatigue crack propagation for most specimens. Propagation is slower in 2124-T851 plate than for 2024-T851 plate but rates for sheet alloys 7475-T61, 7475-T761 and Alclad 7475-T61 are essentially equivalent as are rates for 7175-T736 and 7075-T7352 hand forgings.

The 7175-T736 forgings, 7475-T761 sheet and 2124-T851 plate have a high resistance to exfoliation while the 7049-T73 forging and the 7475-T61 sheet show some susceptibility to exfoliation. All of the materials are resistant to stress corrosion exfoliation. All of the materials are resistant to stress corrosion cracking when stressed in the longitudinal and long-transverse grain direction. The resistance to SCC in the short-transverse direction of all the materials is representative of the respective alloys and tempers.

DD FORM 1 JAN 64 1473

UNCLASSIFIED

Security Classification

14. KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
7049 7175 7475 2124 Aluminum Die Forgings Hand Forgings Sheet Plate Tensile Compressive Shear Bearing Fracture-Toughness Fatigue Crack Propagation Stress-Corrosion Exfoliation						

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization *(corporate author)* issuing the report.

2*a*. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking is to be in accordance with appropriate security regulations.

2*b*. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year; or month, year. If more than one date appears on the report, use date of publication.

7*a*. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7*b*. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8*a*. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8*b*, 8*c*, & 8*d*. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system numbers, task number, etc.

9*a*. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9*b*. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers *(either by the originator or by the sponsor)*, also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified DDC users shall request through
_______________________________."

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through
_______________________________."

(5) "All distribution of this report is controlled. Qualified DDC users shall request through
_______________________________."

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring *(paying for)* the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall end with an indication of the military security classification of the information in the paragraph, represented as *(TS)*, *(S)*, *(C)*, *or (U)*.

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.